A History of the Geology Program at New Mexico State University: 1890 to 2015

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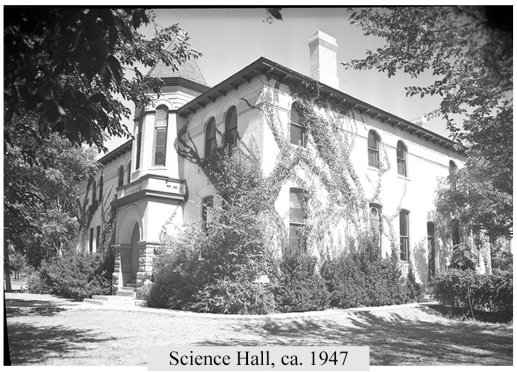

Science Hall, ca. 1947

Science Hall McFie Hall ca. 1910 YMCA Building

Science Hall, ca. 1898

McFie Hall, ca. 1892

New Mexico State University History of the Geology Program 1890 - 2015

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A History of the Geology Program at New Mexico State University 1890 - 2015

Table of Contents

A History of the Geology Program at New Mexico State University 1890 - 2015

Figures

A HISTORY OF THE GEOLOGY PROGRAM AT NEW MEXICO STATE UNIVERSITY: 1890 - 2015

Introduction

"*The agricultural college and agricultural experiment station, created and established by this act, shall be ----devoted to the practical instruction in agriculture, mechanic arts, natural sciences connected therewith, ----. The course of instruction of the college hereby created shall embrace the English language, literature, mathematics, ----, geology, ---- and such other sciences and courses of instruction as shall be prescribed by the regents of this institution of learning.*"

Rodey Act of 1889, Legislative Assembly, Territory of New Mexico.

The Department of Geological Sciences at New Mexico State University (NMSU) is fairly young compared to most academic geology departments in the United States. However, the history behind the department goes back one hundred and thirty years and is complex. The purpose of this special publication is to document the important details behind the founding of the department and to describe the NMSU geology program's evolution and growth to 2015. The program's history is conveniently divided into three administrative phases. Phase I comprises the first 55 years, during which the program's activities were managed by one or two regular academic departments of the University. In the Earth Sciences phase, the geology program was administered as a division, along with one or two other divisions in the same department. In its third phase, the geology program became a regular academic department within the College of Arts and Sciences, its current status.

At the time of the University's centennial in 1988, a short but comprehensive history of the Department of Earth Sciences was published as a short article in the journal *New Mexico Geology* (Seager, 1989) and as a chapter in *New Mexico State University College of Arts and Sciences Centennial History* (King, 1988). This publication also contains histories of the Astronomy department (Beebe, 1988) and Physics department (Liefeld and Radziemski, 1988). The histories of these two departments dovetail with the history of the geology program. Additional historical resources used include Kropp's history of NMSU to 1964 (Kropp, 1972), a history of NMSU's Geography department (Campbell, 2009), a short historical outline of NMSU published in the Aggie Panorama (Hughes, 2013), some important insights into the development of the geology program during the late 1950s and early 1960s, along with information on department research activities (Hawley, 2005), and a history of the New Mexico Water Resources Research Institute (Stucky, 1979). Although these publications provided the framework for the history described in this paper, the bulk of the information needed came from a variety of University sources, most of which were obtained from the University Archives housed in NMSU's library. These resources include

New Mexico State University's undergraduate and graduate catalog collections, College Annual Reports to the President, New Mexico State University class schedules, and files from the departments of Earth Sciences and Geological Sciences that are archived in the University's library. The University Office of Institutional Research and Planning provided a wealth of statistical information on enrollments and degrees granted. Additional information came from annual department newsletters produced by the departments of Earth Sciences and Geological Sciences, my annual department reports submitted to the Dean for the years 1994 through 2003, and materials from the main office of the Department of Geological Sciences; in particular the geology M.S. theses collection and various department files. Finally, important information and insights were obtained directly from many individuals through private conversations or interviews. The scope of this history is limited to the geology program on the main campus of New Mexico State University. Hopefully, others will write histories for the geology programs at the branch campuses of NMSU. Until the year 2000 or so, all geology instructors and geology courses at branch campuses had to be approved by the department head overseeing the geology program at the main campus in Las Cruces. Finally, the coverage of collaborative research, visiting faculty, and invited speakers has been kept to a minimum. To have included these activities would have expanded this history beyond what is needed to tell the main points of the story. For a similar reason, research references were not given. It is hoped that the rich research history of the geology program will be documented by someone in the near future.

First 55 Years: 1890-1945

On February 28, 1889, territorial governor of New Mexico Edmond G. Ross signed into law the Rodey Act, which mandated the establishment of an agriculture college and experiment station at or near Las Cruces, New Mexico. This school was designated by the Territory of New Mexico as New Mexico's land-grant college as defined by two landmark pieces of federal legislation, the Morrill Act of 1862 and the Hatch Act of 1887. Through these enactments, states and territories were encouraged to establish for the average citizen institutions of higher learning that emphasize studies in agriculture and the "mechanic arts", but not to the exclusion of classical programs of study. In addition to establishing what is now New Mexico State University (NMSU) in Las Cruces, the Rodey Act also mandated the founding of a university in Albuquerque, the future University of New Mexico, and a school of mines in Socorro, New Mexico Institute of Mining and Technology. The school of mines was established to provide students with instruction in a variety of science- and engineering- related fields of study including chemistry, mineralogy, geology, mining, milling, and metallurgy. Although geology was to be an important topic of study at the school of mines, the above quote from the Rodey Act clearly states that geology is also to be part of the curriculum at the state's land-grant institution in Las Cruces.

New Mexico College of Agriculture and Mechanic Arts (NM A & M) opened for its first term January 21, 1890 with two professors: Hiram Hadley as president, experiment station director, and

mathematics instructor and John Owen, professor of history and mathematics. The fledgling academic institution was housed in two rented buildings in Las Cruces: an adobe structure located northeast of the railroad passenger station at what is now 301 W. Amador Ave. (current site of Washington Federal Bank) and the DeMier's building, which stood in the vicinity of the original St. Genevieve's Catholic Church in downtown Las Cruces. During the course of the first academic term, four professors were added, including a botanist Elmer Wooton (A.M., Earlham College, 1896) as professor of chemistry and botany and the first geology instructor at the College. The Department of Chemistry and Botany, the administrative unit initially in charge of geologic instruction, was officially established April 15, 1890. In February 1891, the school's faculty and students moved into the first building constructed on campus, McFie Hall (Fig. 1). Remnants of this building are preserved on the green lawn area of the horseshoe between Hadley Hall and Espina Street. In 1893, the chemistry and botany academic unit was split, giving rise to the Department of Botany with Professor Wooton as department head and in charge of teaching geology courses and the Department of Chemistry under Author Goss (M.S., Purdue, 1895), who supervised independent research involving the study and analysis of ores, soils, water, and biological materials. The first and second catalogs of the College, 1890 and 1891, mentioned that geology was to be taken in the junior year. Since the College had one junior by Academic Year (AY) 1891/1992 and six juniors during AY 1892/1893, the first geology course was most likely taught during the fall term of 1892 or shortly thereafter.

During the next nine years, the geology program remained a satellite department of Botany and then the Department of Biology. Professor Wooten oversaw the teaching of geology courses, while at times being assisted by biologists Paul Standly (B.S., NM A & M, 1907), Howard Hammond

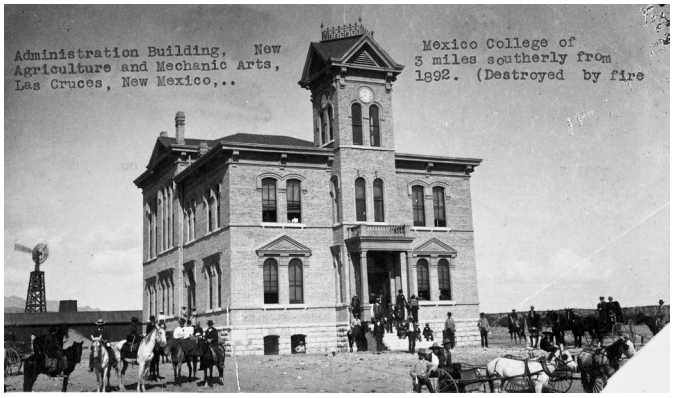

Figure 1. McFie Hall, ca. 1892 (New Mexico State University Library, Archives and Special Collections).

(A.M., University of Illinois, 1909), and Dayton S. Merrill (M.S., University of Iowa, 1910). Assaying was taught as a discipline within the Chemistry department, first under the direction of Professor Goss and from 1903 to 1915 under the second department head of Chemistry, Raleigh Hare (Ph.D., Columbia, 1911). In 1898, the natural science departments on campus were moved to Science Hall, a newly constructed building, which stood in the general area of the present day chemistry-

Figure 2. Science Hall, ca. 1898 (New Mexico State University Library, Archives and Special Collections).

biochemistry complex (Fig. 2). The building was completed during the 1897 fall term and occupied in

January, 1898; the first floor housed the Department of Chemistry, while the Department of Biology, including the geology program, occupied the second floor, along with the physics program. Three years after this move-beginning with the fall 1901 term-responsibilities associated with the geology program were divided between the Department of Biology and Department of Chemistry. Mineralogy was taught through the Department of Chemistry, which also offered courses in metallurgy and assaying. The physical and historical geology curriculum remained the responsibility of the Biology department. All geologic collections were housed on the second floor of Science Hall. The geology program remained stable for the next fourteen years. Toward the end of this stable period, Texas State School of Mines and Metallurgy (the future University of Texas at El Paso, UTEP) was established in El Paso on April 28, 1914 with classes beginning in September of the same year.

During the first week of July, 1913, George Ladd (Ph.D., Harvard, 1894) arrived on campus as president of New Mexico A & M and professor of geology. He was the first Ph.D. geologist to assume responsibility for geologic instruction at the College. In 1915, under the direction of President Ladd, the entire geology program became the responsibility of the Department of Chemistry where recently hired Louis Higley (Ph.D., University of Chicago, 1907) replaced Professor Hare as department head. Professor Higley, a chemist with a geologic background, assisted President Ladd with geology instruction. After President Ladd resigned during the spring term of 1917, Professor Higley organized and taught the geology curriculum. In 1921, Clayton Botkin (A.M., University of Wisconsin, 1914) replaced Professor Higley as head of Chemistry and assumed responsibility for the geology program. Glenn Hamiel (A.M., University of Indiana, 1923), a chemist, assisted Professor Botkin from 1922 to 1927 in teaching geology courses. Professor Botkin remained in charge of geology until shortly after World War II. Geologic instruction from the inception of the geology program to the end of World War II was entirely service oriented in nature. Throughout this period, three main courses were regularly taught, either as an elective or requirement: physical geology, historical geology, and mineralogy. Two other classes were offered for more than 20 semesters during this period; an introductory geomorphology course *Physiography* from academic year (AY) 1915/1916 to AY 1945/1946 and a course in oil geology from AY 1919/1920 to AY 1931/1932.

Earth Sciences Department: The Early Years: 1946–1964

In the year following the end of World War II, James Culbert (Ph.D., Clark, 1939) joined the Department of Business Administration and, as an Associate Professor of Business, taught geography courses through that department. Although Professor Culbert was the University's first Ph.D. geographer, he had a strong background in geology and extensive experience in the petroleum industry. At the time of Professor Culbert's arrival, the College's catalog listed an offering of two geology courses, both taught by Professor Botkin in Chemistry. In 1947, the Department of Geography and Geology was established and both professors initially shared the geology teaching load. In the fall semester of the following year, a Bachelor of Science degree in geography was recognized. For the next fourteen years, Professor Culbert served as the sole member and head of Geography and Geology. He administered the geography degree program, although the bulk of the department's resources were used to provide geology and geography courses required by other programs in the College. The Department remained housed on the second floor of Science Hall until 1961 when it was moved to temporary quarters for several years before moving, in 1963, to Baldwin Hall, across the street from the Branson Hall library. Initially, the Department of Geography and Geology offered eight geography and four geology courses. However, by the fall of 1962, the Department offered 13 geography courses and three geology courses, with an obvious shift in emphasis toward physical and cultural geography.

The New Mexico College of Agriculture and Mechanic Arts was renamed New Mexico State University of Agriculture, Engineering, and Science in December 1958 and it was renamed again New Mexico State University (NMSU) in November 1960. In 1961, Geography and Geology changed its name to Earth Sciences in anticipation of changes already in motion or in the planning stage for the new decade. Nevertheless, in the 1963/1964 Annual Report to the President, the Arts and Sciences dean found it necessary to defend Earth Sciences against those who thought the department should be disbanded and its functions transferred to other departments. He pointed out that increasing demand for courses in the department and the recent staff additions greatly increased the viability of the department. Clyde Tombaugh (D.Sc., University of Arizona, 1960), an

Figure 3. Clyde Tombaugh, 1961 (New Mexico State University Library, Archives and Special Collections).

astronomer and discoverer of Pluto, joined Earth Sciences with a 1/2-time teaching position in 1962 (Fig. 3). Two astronomy courses were added to the department's curriculum and Professor Tombaugh

taught both astronomy courses and the department's introductory geology course *Fundamentals of Geology*. Professor Tombaugh also had a 1/2-time position with the newly instituted Research Center on campus. In addition to the arrival of Professor Tombaugh on campus, several developments within the College of Agriculture and Home Economics during the late 1950s and early 1960s significantly influenced the direction of the geology program within the Department of Earth Sciences.

Leland (Lee) Gile (M.S., University of Wisconsin, 1954), with the Soil Conservation Service (SCS) of the United States Department of Agriculture (USDA), came to Las Cruces in 1957 to lead the soil-science phase of the Desert Soil-Geomorphology Project headquartered at New Mexico State University. This project involved the investigation of soils, late Cenozoic geology, hydrology, and soil-geomorphic relationships in southern New Mexico and adjacent areas. John Hawley (Ph.D., University of Illinois, 1962), an areal geologist with the SCS, came to Las Cruces in 1962 to serve as the NMSU Agriculture Experiment Station's geologist and to lead the Desert Soil-Geomorphology Project. In the 1970/1971 graduate catalog, both he and Leland Gile are listed as U.S.D.A. cooperating faculty members in the Department of Agronomy. John Hawley also served as the first geologist associated with the Water Resources Research Institute (WRRI) on the NMSU campus. This university research organization was founded in 1963 to facilitate the training of water scientists and water engineers through research and investigation of water problems in cooperation with the Agriculture Experiment Station. The geologic input of doctors Gile and Hawley was an important component of many studies sponsored and carried out by the Desert Soil-Geomorphology Project and the WRRI through the Agriculture Experiment Station. As a result of this geologic activity, the University's administration decided that a geologist should be housed in Earth Sciences as a regular faculty member, with the expectation that the research interests of this geologist would, in part, overlap with those of the WRRI and Agriculture Experiment Station. As a consequence of this decision, William King (Ph.D., University of Wisconsin, 1959) joined the Earth Sciences department in September of 1964 as its third member. Professor King specialized in the use of fusilinids as a stratigraphic tool and came to NMSU with experience in university administration and the petroleum industry. He focused his research efforts in three general areas: oil and gas potential in specific basins of New Mexico and Texas, stratigraphic studies in southern New Mexico, and hydrogeological studies in Doña Ana County, New Mexico.

Geology Program Development: 1965–1972

The geology program within the Department of Earth Sciences took a major leap forward with the arrival of Professor King. As the department's sole Ph.D. geologist, he was responsible for the geology curriculum and the development of a Bachelor degree program in geology. Professor Tombaugh no longer had to teach *Fundamentals of Geology* and was able to focus completely on the astronomy program. In 1966, a second geologist, William Seager (Ph.D., University of Arizona, 1966) was added to the geology faculty (Fig. 4). His position was initially

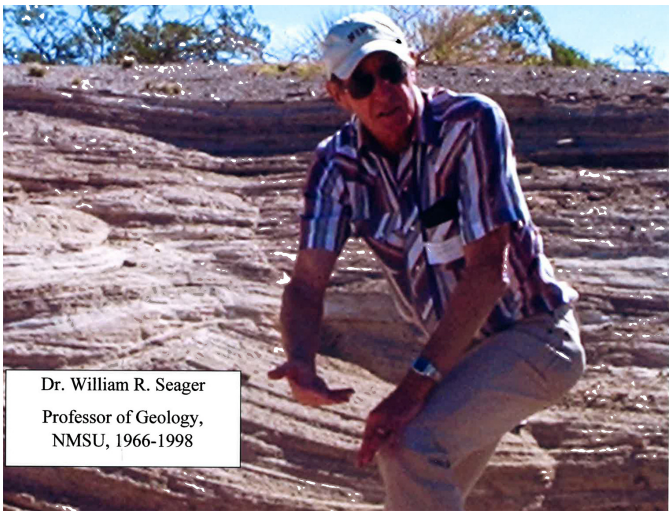

Figure 4. William Seager, Kilbourne Hole field trip, 2007 (New Mexico State University Department of Geological Sciences).

supported equally by the University and Professor Tombaugh's grant to study the geology of the moon. Professor Seager specialized in field mapping with an emphasis on structural and tectonic relationships. In the following year, a Bachelor of Science degree in geology was established, beginning with the fall 1967 semester. This degree was established primarily through the efforts of professors Culbert and Tombaugh, who promoted the degree's cause within the College of Arts and Sciences. Professor Culbert mentioned in the 1967/1968 Annual Report to the President that the geology program had 18 majors in the fall of 1968 and that this is a testament to the popularity of the new B.S. degree in geology offered by the department. In the report, it is also noted that the geology club is active. From 1965 through 1967, additional faculty and staff were hired by the Earth Sciences department, bringing the total to nine: two geologists, three geographers, and four astronomers. In recognition of the growing importance of the astronomy program, the name of the department was expanded in 1967 to Earth Sciences and Astronomy.

In 1968, Professor King assumed the duties of department head, replacing Dr. Culbert, who retired the following year. A major milestone for the geology program was achieved in 1969 when the department's first Bachelor of Science degree in geology was awarded to Marsha Williams at the May 31st commencement. In the fall of the same year, a third geologist, Russell Clemons (Ph.D., University of Texas, Austin, 1966), joined the geology faculty

Figure 5. Russell Clemons (left) and William King, NMGS field trip, 1970s (New Mexico State University Department of Geological Sciences).

in support of the new degree in geology (Fig. 5). Professor Clemons' areas of interest were mineralogy, petrography, economic geology, and field mapping with an emphasis on structural relationships and petrology. By the close of the 1960s the geology major enrollment was impressive for a program only two years old; of the 68 undergraduate majors in the department, 45 were in the geology program.

In the fall of 1969, a Ph.D. program in astronomy was established in the Department of Earth Sciences and Astronomy. However, in July of the following year, the astronomy group with a faculty of five, separated from geography and geology to form the Department of Astronomy. The remaining programs, geology and geography, returned to their previous name, Department of Earth Sciences, now comprising a faculty of four geographers and three geologists. In the fall of 1970, Lester Tofte (B.S., University of Houston, 1970) was hired by the department as a ¾-time instructional assistant to coordinate and teach geology labs. In the following year he was promoted to a full time geology instructor. Between 1961 and 1971 the Earth Sciences department grew from a faculty of one to a faculty of eight, four geologists and four geographers. The University's undergraduate catalog for AY 1970/1971 lists 25 geography courses and 17 geology courses. Research as an important component of the geology program at NMSU began with the arrival of William King in 1964 and, by 1972, the program had established a strong research effort focusing on field studies in southern New Mexico and adjacent areas. Initially, Professor King undertook several studies funded by the New Mexico Bureau of Mines and Mineral Resources (NMBMMR) including the hydrogeology of the Rio Grande valley in southern New Mexico and the hydrogeology of Doña Ana County. He also investigated the geology, fusilinid micropaleontology, and sedimentology of several stratigraphic units in New Mexico and adjacent areas. William Seager conducted three studies funded in part by the NMBMMR: an investigation of the Cenozoic stratigraphy of the Rio Grande valley area in Doña Ana County, NM and two studies conducted with Russell Clemons: the geology of the San Diego Mountain area in south central New Mexico and the geology of the Souse Spring quadrangle in the Sierra de la Uvas of southern New Mexico. He also worked with Clyde Tombaugh in an investigation of circular geologic features (impact craters and volcanoes) in New Mexico and adjacent states with the goal of being able to identify such features on the moon. This group of investigations, conducted between 1964 and 1972, set in motion a research focus that continues today in the Department of Geological Sciences: the understanding of New Mexico geology through field studies in southern New Mexico and adjacent areas.

Geology Program Growth Years: 1972–1980

The Earth Sciences department underwent rapid and extensive changes over the course of the next eight years. Key developments included the offering of three new degrees and the initiation of three major cooperative programs with other academic units. A third Bachelor of Science major, City and Regional Planning, was established in 1973. The two new geology degrees are described below, as are the three cooperative programs. As a result of these academic initiatives and corresponding increase in the size and diversity of its faculty, Earth Sciences was able to accommodate the ongoing increase in enrollments. This was important because geography and geology enrollments were on a steep upward trend during the 1970s and the curriculums of both programs were being rapidly developed during this period; in short, the increase in faculty size was able to keep pace with the growing and evolving teaching load. For a more thorough discussion of geology major enrollments, see Appendix I. The department was also beginning to establish national recognition. In the fall of 1973, Earth Sciences was instrumental in bringing to campus Charles Hunt, a geologist from Johns Hopkins University, as a University Distinguished Visiting Professor. He taught courses in geology and anthropology during the 1973-1974 AY, but remained on campus for several more years as an adjunct distinguished visiting professor.

A cooperative elementary education degree specializing in earth sciences was established and offered for the first time in AY 1972-1973. This major was developed in cooperation with the College of Education and other departments in the College of Arts and Sciences. Students interested in this teaching major registered in the College of Education and had advisors in the Department of Elementary and Secondary Education and the Department of Earth Sciences. This degree has been offered continuously since its inception almost fifty years ago; a description of this major can be found in the 2014/2015 undergraduate catalog. For the geology program, a key factor in its development during the 1970s was the founding of two additional cooperative programs: geological engineering and geophysics. In the fall of 1972, a Bachelor of Science degree in geological engineering was initiated as a cooperative effort between the geology program in Earth Sciences and the Department of Civil Engineering in the College of Engineering. The geological engineering (G EN) program was administratively housed in Civil Engineering and existing courses in geology and engineering were used to support the geology and engineering course requirements for the new degree. Civil Engineering had primary responsibility for granting the degree. Students who elected this course of study registered in the College of Engineering, although faculty advisors were available in Earth Sciences to assist students regarding the geology component of this degree. Initially, Narendra Gunaji (Ph.D., University of Wisconsin, 1958) was the sole geological engineer in the Civil Engineering department; however, various required engineering courses in the G EN program were taught by other civil engineering faculty members. At the start of the 1975-1976 AY, the geological engineering program was beginning its fourth year. The success and popularity of the program was documented in Civil Engineering's 1975 Annual Report to the President by the statement that the G EN program had six graduates since its founding three years earlier. In

August of 1976, Lokesh Chatuvedi (Ph.D., Cornell University, 1969) joined the G EN faculty with ½-time positions in both Civil Engineering and Earth Sciences; he was administratively housed in Civil Engineering. Professor Chaturvedi directed the G EN program and became the *de facto* liaison between Earth Sciences and Civil Engineering. Although Professor Gunaji would remain full-time in Civil Engineering, the plan at this time was to form a joint-faculty program in which future G EN faculty members would be hired with joint positions.

Interest in energy research and development was sparked in the early 1970s by the "Arab oil embargo." In addition to exploration and production research in the area of traditional sources of energy, there was nationwide interest in the development of alternative energy sources, including geothermal resources. In early 1974, the College of Arts and Sciences was working with the NMSU University Research Council to encourage research in the area of energy. In response to a state appropriation for energy research, proposals were submitted by a dozen or so faculty members from Arts and Sciences, including Chandler Swanberg (Ph.D., Southern Methodist University, 1971) who had not yet arrived on campus as the first geophysicist hired by the University. He submitted a proposal with a geothermal resource theme. Dr. Swanberg joined the departments of Physics and Earth Sciences in August of 1974 with ½-time positions in both departments; he was administratively housed in Physics. Professor Swanberg came to NMSU from the United States Bureau of Reclamation and specialized in heat flow, exploration geophysics, geothermal resources, and solid earth geophysics. With the arrival of Professor Swanberg, a joint-faculty geophysics program was established, with geothermal resources as the program's main focus of research (see Appendix II). Two additional geophysicist were hired in the fall of 1975. Paul Morgan (Ph.D., London University, 1973), from Southern Methodist University, joined the departments of Earth Sciences and Physics as an assistant professor of geophysics, with ½ time positions in both departments. Professor Morgan specialized in potential fields, heat flow, micro-seismic activity, geothermal resources, and rift geodynamics. In addition to his research duties, Professor Morgan taught the introductory geology course *Survey of Geology* and three geophysics courses: *Introduction to Seismology*, *Advanced Seismology*, and *Potential Fields*. Charles Stoyer (Ph.D., Penn State, 1974), who specialized in electromagnetism, joined Earth Sciences and Physics as a research associate at the assistant professor level (Fig. 6). He taught the course series *Physics for Engineers,* in addition to assisting doctors Swanberg and Morgan in a survey of geothermal waters from Arizona and New Mexico. Undergraduate and graduate geophysics courses were listed in the University catalog under the prefix GPHY. By the fall of 1977, geology students had access to graduate and upper level undergraduate

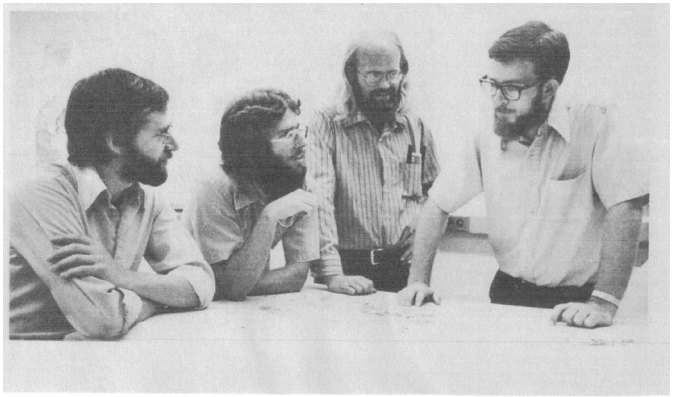

Figure 6. Geophysics professors (left to right) Paul Morgan, Charles Stoyer, Chandler Swanberg and geophysics Ph.D. student, Paul Dagett (right), 1976 (New Mexico State University 1977/1978 Graduate Catalog).

courses in geophysics (e.g., *Solid Earth Geophysics* and *Exploration Geophysics*), while physics students could earn a B.S., M.S. or Ph.D. in physics with an emphasis in geophysics. Students in the geophysics program who did not have a geology background were required to take *Petrology for Geophysicists*, *Structural Geology*, and the introductory geology course *Fundamentals of Geology*.

The geology program in Earth Sciences underwent important changes in 1976. In May, Mr. Tofte resigned as geology instructor to pursue a Ph.D. in the College of Education. In the fall, Professor Chaturvedi, as mentioned above, and two additional faculty members joined the Earth Sciences department. Jerry Mueller (Ph.D., Johns Hopkins University, 1973), a physical geographer, provided the needed bridge between the geology division of the department and a geography program that emphasized cultural studies. Professor Mueller specialized in fluvial geomorphology, cartography, and environmental geomorphology. In addition to teaching classes in cultural geography, Professor Mueller taught courses in cartography and developed an undergraduate geomorphology course suitable for geology and G EN majors. William Partin (Ph.D. candidate, University of Wyoming) was hired to cover the department's shortcoming in the area of sedimentology. Mr. Partin resigned in 1978 and to cover his scheduled courses for the following year, the department hired Robert Robinson (Ph.D. candidate, University of Texas, El Paso) as a temporary instructor.

Various department milestones unfolded throughout the second half of the 1970s. During the Christmas break of 1976, the department moved from Baldwin Hall, a building with facilities dating from the mid-1930s, to the newly renovated Breland Hall, a former men's residence hall completed in 1955 and modified in 1976 to house the Arts and Sciences office complex and a half dozen or so departments in the College (Fig. 7). Along with the renovation of the original building, two major additions were constructed: a laboratory wing and the main office of the College of Arts and Sciences. Earth Sciences occupied the first floor and basement of the renovated east wing and was initially given, in the new laboratory wing, three teaching laboratories, a modern geochemistry lab, and two other rooms. One of these rooms was used for cartography teaching and research, while the other housed the department's rock preparation and thin section laboratory. In the fall of the following AY, 1977/1978, a Bachelor of Geological Sciences degree was established. This degree was

Figure 7. Breland Hall, 1996. On the left is an entrance to the main wing of Geological Sciences and to the right is the lab wing (courtesy of Thomas H. Giordano).

similar to the B.S. degree in geology; however, it did not have a foreign language requirement. As a substitute for the second language, students working toward a Bachelor of Geological Sciences degree were required to take additional courses in technical writing, statistics, and computer science.

To further support the geothermal efforts of the

geophysics program, two post-doctoral research associates were hired through the geophysics program in the fall semester of 1977: Thomas Giordano (Ph.D., Penn State, 1978) and Charles Young (Ph.D., University of Wisconsin, 1977). They were physically housed in Earth Sciences and Physics, respectively, but both had ½-time positions in Earth Sciences and Physics. Dr. Giordano specialized in theoretical and experimental geochemistry of hydrothermal systems, particularly those related to ore-forming processes. He was brought on board to evaluate, through the use of chemical models, the geothermal potential of groundwater and spring water samples collected in potential geothermal resource areas and from reconnaissance surveys. In addition to his research duties, Dr. Giordano developed and taught four courses: *General Geochemistry*, *Aqueous Geochemistry*, *Economic Geology*, and *Petrology/ Petrology for Geophysicists*. Dr. Young, a geophysicist with expertise in electrical resistivity and electromagnetism worked on various geothermal projects in addition to teaching courses for the Department of Physics. He was promoted in 1978 to the position of research associate at the Assistant Professor level. On July 1st 1978, Professor Clemons replaced Dr. King as department head of Earth Sciences and in the fall of the following year, Dr. Giordano was promoted to Visiting Assistant Professor of Earth Sciences.

In January of 1980, Professor Giordano joined the Earth Sciences faculty as a tenure track Assistant Professor. As the department's geochemist, he assumed responsibility for the geochemistry laboratory and began constructing a hydrothermal lab in space made available by moving the rock saw and thin section equipment to the basement of Breland Hall. In the fall of 1980, Greg Mack (Ph.D., Indiana University, 1977) and Dean Clauter (Ph.D., University of Pittsburgh, 1979) joined the Earth Sciences department as tenure-track assistant professors (Fig. 8). Greg Mack, who specialized in sedimentology, stratigraphy, and field mapping, filled the department's gap in the area of sedimentology. Dr. Clauter's expertise was in the area of rock magnetism and paleomagnetism. He joined the geophysics program as an assistant professor with a ½-time position in both Earth Sciences and Physics. Professor William Sublette (Ph.D., University of Arizona, 1979) from Civil Engineering was appointed to the G EN faculty with ½-time positions in Earth Sciences and the Department of Civil Engineering, where he was administratively housed. Professor Sublette specialized in geotechnology. Meanwhile, at the end of the 1980 summer session II, professors Young and Morgan resigned and took positions at Michigan Tech and the Lunar and Planetary Institute in Houston, TX, respectively. Professor Morgan remained part of the geophysics

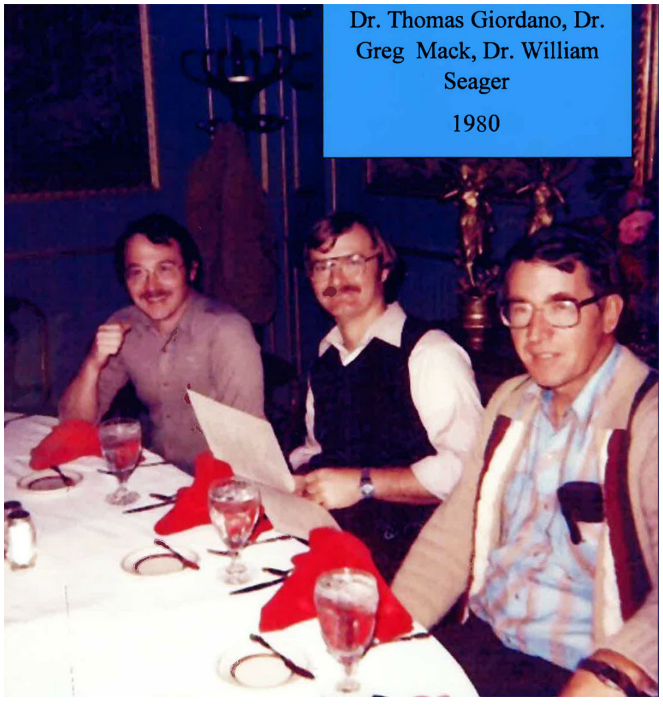

Figure 8. Thomas Giordano, Greg Mack, and William Seager, 1980 (New Mexico State University Department of Geological Sciences).

program as an Adjunct Professor through the spring semester of 1983.

The Department initiated its first graduate program by offering a Master of Science degree in geology beginning the fall semester of 1980. The requirements established for this degree were similar to those currently in effect and outlined in the 2014/2015 graduate catalog. The department's first graduate class comprised six students, supported by six teaching assistantships. With the department's geology graduate program established and running smoothly, Professor Clemons stepped down as department head in July of 1981, while Jerry Mueller took on the headship in time for the beginning of the 1981/1982 AY. The department's first Master of Science degree in geology was awarded to Keith Rasmussen at the May, 1982 commencement.

The growth of geology's faculty and academic program in the 1970s was accompanied by the expansion of its research activities. Over the decade, doctors King, Seager, and Clemons joined forces with geologists from the NMBMMR and other universities, as well as the geophysicists at NMSU, to form a large and talented research team. Although geology's in-house laboratory facilities were limited, Seager and Clemons routinely used outside labs to obtain chemical and isotopic analyses and age dates for their studies. The Earth Sciences department had the capability of producing thin sections and polished sections. The principal research focus of the geology program remained southern New Mexico but the scope was expanded beyond mapping of quadrangles and conducting stratigraphic, petrologic, hydrogeological, and paleontological studies. Professor Seager worked with Paul Morgan in the geophysics program and UTEP professor Randy Keller to study the geology and tectonic features of the Rio Grande rift in south central New Mexico and adjacent areas of west Texas and Chihuahua. Russell Clemons investigated mineralization and ore deposits in horst blocks of the Basin and Range in southern New Mexico, especially those associated with Tertiary volcanic centers.

With the arrival of Chandler Swanberg on campus, geothermal exploration and resource evaluation became the dominant research focus of the geophysics program, with funding primarily administered through the Department of Physics. By 1979, the geothermal team comprised professors Swanberg and Morgan; a geophysics research associate, Dr. Young; a geochemist, Dr. Giordano; several geophysics M.S. and Ph.D. students; and several undergraduate geology majors. The study of continental rift systems (geology, geophysics, origin, and development) became a second focus of the program under the direction of Professor Morgan.

Geology Program Restructuring: 1981 - 1989

After eight years of extensive and complex evolution, the geology program needed to adjust its curriculum and overall scope of operation in response to its new status as a graduate program, the growing and diverse faculty, and the unexpected reality of a major downturn in undergraduate geology enrollments (see Appendix I). Significant personnel changes took place early on during this period. At the beginning of the spring 1981 semester, Professor Sublette in the G EN program was replaced by Timothy Ward (Ph.D., Colorado State University, 1976), who specialized in hydrology and geotechnology. In August, Mark Odegard (Ph.D., University of Hawaii, 1975) and John Cabrera (Ph.D., Cornell University, 1971) arrived on campus as faculty members of the geophysics and G EN programs, respectively. Dr. Odegard joined the geophysics program as an associate professor with ½-time positions in Physics and the Department of Earth Sciences, where he was administratively housed. Professor Odegard, a seismologist, came to NMSU from the Office of Naval Research. Dr. Cabrera joined the G EN faculty with ½-time positions in Civil Engineering and the Department of Earth Sciences, where he was administratively housed. Professor Cabrera worked for industry as an engineering geologist before coming to NMSU.

In the 1981/1982 undergraduate catalog, geological engineering courses were identified for the first time with the G EN prefix. The following courses were listed: (*Geological Engineering Techniques, Rock Mechanics, Subsurface Resource Evaluation, Geohydrology, Site Evaluation, and Special Topics*). By the spring of 1982, the geology program still lacked a faculty member who specialized in igneous petrology. To fill this gap, the Earth Sciences department hired Michael McCurry (Ph.D., UCLA, 1985), who arrived on campus at the start of the 1982/1983 AY. Professor McCurry specialized in igneous petrology and volcanology. He taught courses in igneous and metamorphic petrology and eventually designed and taught a course in analytical geochemistry. He also team taught a course in geochemical thermodynamics with Professor Giordano. Over the course of the mid-1980s, Professor McCurry founded and developed the department's Analytical Geochemistry Research Laboratory (AGRL) which included a Rigaku X-ray diffractometer and a Perkin-Elmer ICP spectrometer. Work conducted under the AGRL umbrella also utilized sample preparation equipment available in the geochemistry laboratory and the department's rock preparation facility (rock crusher and rock mill).

In January of 1983, several important personnel changes took place in the Department of Earth Sciences including those required to cover the teaching and department head duties of Professor Mueller, who started a twelve month sabbatical at the beginning of the spring 1983 semester. To cover his teaching responsibilities in the areas of geography and geomorphology, the department hired Richard A. Earl (Ph.D., Arizona State University, 1983) as a visiting assistant professor under a one-year contract. Professor Cabrera was appointed acting department head for the spring 1983 semester and became a full-time faculty member in Earth Sciences; he remained a member of the G EN faculty. Dr. Clemons assumed the position of

acting department head for the Fall 1983 semester. In addition to these personnel changes within Earth Sciences, Professor Chaturvedi, who directed the G EN program since 1976, left NMSU in January 1983 for a state environmental-oversight position in Santa Fe. At the start of the 1983/1984 AY, the Department of Earth Sciences comprised a faculty of fifteen: six geographers (Mueller, Sheck, Kunkel, Gribb, Czerniak, and Earl); six geologists (King, Seager, Clemons, Giordano, Mack, and McCurry); two geophysicists (Swanberg and Odegard); and one geological engineer (Cabrera). There were no adjuncts.

By the spring of 1983, the department offered a M.S. degree in geology and four Bachelor degrees (three B.S. degrees: city and regional planning, geography, and geology, and a Bachelor of Geological Sciences degree). Geology undergraduate enrollments dropped a little from the high in AY 1981/1982 to 112; 91 students were working toward a B.S. degree in geology while twenty one majors were enrolled in the Bachelor of Geological Sciences program. Twenty one geology majors were enrolled in the department's graduate program. In addition to these geology degrees, Civil Engineering offered a Bachelor of Science degree in geological engineering and a M.S. degree in civil engineering in which a student could specialize in geological engineering. The physics department offered an emphases in geophysics with each of its three degrees in physics (B.S., M.S., and Ph.D.). Although a geophysics student could enroll as an undergraduate major, the geophysics program was, and still is, primarily geared toward graduate students.

Professor Mueller resumed his duties as department head in January 1984. Professor Earl was rehired for the AY 1984/1985 and continued teaching geography courses; however, geomorphology classes were once again the responsibility of Professor Mueller. In May, both geophysicists (Swanberg and Odegard) resigned to take positions in the private sector. Swanberg and Odegard were replaced by two seismologists, Roger Greensfelder (Ph.D., Stanford University, 1981) and James Ni (Ph.D., Cornell University, 1984). They arrived in August to begin a new phase in the history of the geophysics program. Professor Greensfelder came to NMSU from an engineering firm where he worked on earthquake hazard projects. Although he had experience in geothermal resources, his interests were primarily seismology and applied geophysics. He was hired at the associate professor level with a full faculty position in Earth Sciences. Professor Ni, with expertise in seismology and tectonics, joined the geophysics program with ½-time positions in both Earth Sciences and Department of Physics, where he was administratively housed. In July, Robert Myers (M.S., Kent State University, 1978) joined Earth Sciences as an adjunct instructor to teach courses in geohydrology for geology and G EN students. Mr. Myers was employed by the NMSU field office of the United States Geological Survey (USGS) Water Resources Division and was housed on campus at the WRRI.

At the end of the spring 1985 semester, Professor Cabrera retired. His position on the G EN faculty was filled in time for the fall semester by Harold Ganow (Ph.D., University of Illinois, 1975), who assumed his duties as a full time member of the Civil Engineering faculty. Professor Ganow taught *Fundamentals of Geology*, the department's advanced introductory geology course for civil engineering majors. With these changes,the G EN faculty now stood at three (Aiyer, Ganow, and

Ward). In the following AY (1986/1987), Civil Engineering changed its name to Department of Civil, Agriculture, and Geological Engineering, CAGE for short. With the departure of Swanberg and arrival of professors Ni and Greensfelder in 1984, the research focus of the geophysics group shifted from geothermal to seismology and tectonics. Professor Ni initiated at this time his work on the nature of the crust-mantle structure beneath the Himalayas and Tibetan Plateau. A change in the joint nature of the geophysics program took place in AY 1985/1986. Professor Greensfelder resigned in 1986 and returned to industry, while Professor Ni became full time in Physics. These personnel changes marked the end of geophysics' joint geology-physics faculty structure. Henceforth, the geophysics program was housed completely in the Department of Physics. Nevertheless, Earth Sciences continued to support the geophysics program by teaching geology courses required for the program and geology students continued to have access to geophysics courses.

In August of AY 1986/1987, Professor Mueller stepped down as department head to be replaced by William King. In the same month Timothy Lawton (Ph.D., University of Arizona, 1983) arrived on campus as the second sedimentologist in the Department of Earth Sciences. Professor Lawton's expertise comprised the areas of sedimentology, stratigraphy, and basin analysis. He shared teaching responsibilities with Greg Mack in the areas of sedimentary petrology and stratigraphy. In the fall of 1987, Baldwin Hall which housed the geology program between 1963 and 1976 was demolished to make way for construction of the new Science Hall. In the fall of 1988, Professor Ganow moved from full time in CAGE to ¾-time CAGE and ¼-time Earth Sciences; however, he resigned in May of 1989 to take a position with the USGS in Colorado. With the departure of Harold Ganow, the G EN program became an academic unit housed completely in CAGE, with only CAGE faculty in the G EN group. The geology faculty continued to teach all geology course requirements for the G EN program as well as *Fundamentals of Geology* required for undergraduate civil engineering majors. In October of 1988, Professor King resigned as department head and passed the scepter to Russell Clemons. Professor King retired May 31 of the following year. Also, at the end of the 1989 spring semester, the department's igneous petrologist Michael McCurry resigned to take a position at Sul Ross State University in Alpine, Texas. In the fall, Nancy McMillan (Ph.D., Southern Methodist University, 1986) left Eastern Illinois University and joined the geology program as McCurry's replacement (Fig. 9). Her areas of expertise were igneous petrology, volcanology, mineralogy, and analytical geochemistry. Professor McMillan's teaching responsibilities included *Mineralogy,* courses in igneous and metamorphic petrology, and courses in

Figure 9. Nancy McMillan (courtesy of Nancy McMillan).

analytical geochemistry. She also became director of the AGRL.

The research output of the geology program greatly expanded during the 1980s. This productivity was due in part to the graduate program and supervised thesis research projects, most of which involved field areas in southern New Mexico. Seager, Clemons, and Mack were first authors or co-authors of numerous publications on the geology of southern New Mexico, including geologic maps. Many of these studies focused on the geology and tectonics of the Rio Grande rift and both Cenozoic volcanic- and Laramide- features within the Basin and Range. In the late 1980s, Professor Mack initiated his study of paleosols in southern New Mexico. In this effort, he and his coworkers used stable oxygen and carbon isotopes of paleosols to determine paleoclimate at the time of soil formation in rocks ranging from late Pennsylvanian to Quaternary in age. Professors King, Giordano, McCurry, and Lawton also carried out studies in southern New Mexico, while also conducting research with themes not directly connected to New Mexico. The department gained a reputation during the second half of the 1980s for a strong sedimentary geology program. This was due for the most part to the work of doctors Mack and Lawton, with Russell Clemons contributing to this effort through his studies of carbonate rocks. Clemons, King, and Giordano continued their studies in economic geology, while Dr. Giordano brought his hydrothermal lab up to speed and was active in carrying out experimental and modelling investigations of metal speciation in aqueous fluids from ambient surface environments to hydrothermal environments associated with cooling intrusions and crustal circulation. The AGRL facility provided faculty and student researchers the opportunity to perform some chemical analyses in house.

In the mid-1980s, members of the Earth Sciences faculty were having serious discussions concerning the possibility of forming a separate department for each of the two disciplines in the Department of Earth Sciences. Over the years, geography and geology grew apart in terms of discipline focus. By the end of the decade, the geography program was primarily concerned with instruction, research and applied projects that emphasized cultural and social elements of society, and was moving away from geography as a physical science. Each discipline felt a bit stifled, as the advancement of one usually had little or no positive effect on the other. The lone synergistic dynamic in the department involved the activities of the physical geographer, Professor Mueller, who served geology's graduate and undergraduate programs in the area of geomorphology. Although the two programs were nearly equal in terms of staffing, number of majors, and number of degrees offered, funding and space were not equally allocated and competition for available resources became more intense as the new decade drew near. In spite of the above department profile, relations between the two disciplines remained cordial. By 1989, the department had obtained the necessary approvals for a formal split and dissolution of Earth Sciences and the establishment (on July 1st, 1992) of two new departments: Geography and Geological Sciences.

Transition: 1990 - 1992

Professor Mack replaced Russell Clemons as department head of Earth Sciences in 1990. While Greg Mack was the official interface between Earth Sciences and the College of Arts and Sciences, the department carried out most business as a co-department head organization. As one of the two co-department heads, Professor Czerniak administered the geography division, while Greg Mack oversaw the geology program. In his dealings with the dean's office, Professor Mack would consult Dr. Czerniak on all matters concerning the geography program. Each division also had its own secretary and office. The Earth Sciences' secretary was assigned to geography, while geology hired a new secretary. In addition to handling routine academic business, Czerniak and Mack worked with the Dean's office in the difficult but necessary task of allocating space and resources between the two divisions.

As the July 1st, 1992 deadline approached, most of the transition business had been completed and the two divisions became two departments in time. The final personnel change within the Department of Earth Sciences was the retirement of Professor Clemons on June 30, 1992, one day before the split. As mentioned earlier, Earth Sciences had moved to Breland Hall during AY 1976/1977. By the time of the split, the department occupied most of the east wing's first floor and the entire basement of the east wing, and about one third of the lab addition. After the dissolution of Earth Sciences in 1992, both Geography and Geological Sciences occupied essentially the same space they had as programs in the Department of Earth Sciences; only a few changes were made in space allocation between the two units. With respect to Geological Sciences, the department office complex, all faculty offices, some graduate student offices, and the department's computer and X-ray labs were located on the first floor of the east wing. Most of the department's rock preparation equipment (rock saws, thin section lab, rock crusher, and rock mill) were in the basement along with storage areas. In the laboratory addition, the department had three 500-sq.-ft. rooms used for teaching labs and classes. One of these rooms was the department's petrography lab, which was used for teaching and research. The Breland Hall laboratory addition also housed four department laboratories (geochemistry, hydrothermal, polished section preparation, and ICP), graduate student offices, and some storage space. The department also had an office room on the 3th floor of Breland Hall's east wing.

In Table 1, profiles are summarized for the Department of Earth Sciences at the beginning of AY 1991/1992 (the last academic year before the split) and the Department of Geological Sciences at the beginning of AY 1992/1993, its first academic year after the split. A comparison of the two profiles shows that department personnel were nearly equally apportioned. Geological Sciences, however, received 2/3 of the 16 teaching assistantships available through the Graduate School. At the beginning of the department's first academic year, it had 26 undergraduate majors and 16 graduate students enrolled.

Table 1. Profiles of Earth Sciences (Fall 1991) and Geological Sciences (Fall 1992)

Department of Earth Sciences, Fall 1991

Faculty	Technical Staff	Degrees offered	U S M	G S M	T A
Clemons	Coppedge	B.S. in Geography	66	38	16
Conroy	Myers	B.S. in Geology			
Czerniak	Odenheim	B.S. in City and Regional Planning			
Giordano		Bachelor of Geological Sciences			
Lawton		M.S. in Geology			
Mack		Master of Applied Geography			
McMillan					
Mueller					
Peters					
Reed					
Seager					
Wright					

Department of Geological Sciences, Fall 1992

Faculty	Technical Staff	Degrees offered	U S M	G S M	T A
Giordano	Myers	B.S. in Geology	26	16	11
Gutierrez		Bachelor of Geological Sciences			
Lawton		M.S. in Geology			
Mack					
McMillan					
Seager					

USM = Undergraduate Student Majors
GSM = Graduate Student Majors
TA = Teaching Assistantships

Department of Geological Sciences: 1992 - 2002

The Department of Geological Sciences began the 1992 fall semester in good form with six faculty members, including Russell Clemons' replacement Melida Gutierrez (Ph.D., University of Texas - El Paso, 1992), who joined the department that fall. Professor Gutierrez specialized in geohydrology, environmental geology, and low temperature hydrochemical systems. Although she resigned in June of the following year to join the faculty at Southwest Missouri State University, Dr. Gutierrez's replacement Katherine (Kate) Giles (Ph.D., University of Arizona, 1991) was able to join the Geological Sciences faculty in time for the 1993/1994 AY. Kate Giles came to NMSU from the Exxon Production Research Laboratory in Houston, TX, where she spent two years as a senior Carbonate

Figure 10. Kate Giles (right) and alumnus Rick Kelley, Point of Rocks field trip, 2009 (courtesy of Thomas H. Giordano).

Research Geologist (Fig. 10). Her research at the time focused on carbonate sedimentology and stratigraphy with applications to regional tectonic problems. Professor Giles' teaching responsibilities included a section of *Survey of Geology*, *Invertebrate Paleontology*, and the development of undergraduate and graduate courses in carbonate petrology. With the arrival of Kate Giles, the department entered a period of stability that lasted eighteen years. Although the geology program during this period established a national and international reputation, it had to deal with the problem of low undergraduate enrollments. The geophysics program remained stable between 1984 and 1987, with a single faculty member, Professor Ni. Stephen Salyards (Ph.D., California Institute of Technology, 1989) was hired by Physics as a post-doctoral fellow in 1988 and as a college assistant professor from 1989 to 1991. Dr. Salyards specialized in paleomagnetism and collaborated with Dr. Mack in his study of paleosols by providing paleomagnetic reversal data. In August of 1990, Thomas Hearn (Ph.D., California Institute of Technology, 1985) was hired by the Department of Physics to bolster its geophysics division. Dr. Hearn specialized in seismic tomography as applied to studies of mantle and crustal anisotropy. Thus, the use of seismic data to study the crust/mantle boundary, particularly beneath the Tibetan Plateau, and regions of crustal tectonic deformation remained the focus of the program's research. Geophysics functioned successfully as a two-person graduate program into the mid-1990s. In the fall of 1996, Physics hired a third geophysicist Viatcheslov (Slava) Solomatov (Ph.D., Moscow Institute of Physics and Technology, 1990), a specialist in theoretical geodynamics.

In June of 1994 Greg Mack stepped down as department head and joined the ranks of the regular Geological Sciences faculty. The following day Professor Giordano became the second department head of Geological Sciences. By this time the

department was already in the process of tackling the problem of low undergraduate geology major enrollments. Two important changes to the undergraduate curriculum were made over the course of the next year and these changes became effective with the 1995–1996 undergraduate catalog. The "area of concentration" requirement was replaced by an "elective" requirement and the Bachelor of Geological Sciences major was dropped. The department's advanced introductory geology course, *Fundamentals of Geology*, was dropped and the approximately 50 to 60 civil engineering students, who normally took this course each semester, were now required to enroll in the department's remaining introductory geology course, *Survey of Geology.* The core geology curriculum, including department and non-department requirements remained the same. These changes were made to better facilitate class scheduling in the wake of the large drop in undergraduate geology majors. Other changes, described below, were made in the mid-1990s to enhance the department's research and teaching missions.

By the early 1990s, the Geological Engineering program was under stress. The number of majors dropped to 12 and the program ran into trouble with its accreditation agency, the Accreditation Board for Engineering and Technology (ABET). The G EN faculty consisted of one, the program director, Joseph Finney (Ph.D., University of Wisconsin, Madison, 1962), who was hired in August 1991 to lead the G EN program. In August of 1993, John Zellmer (Ph.D., University of Nevada, Reno, 1980) was brought on board to assist Dr. Finney in the effort to reinvigorate the program. Relations between geology and geological engineering became a bit strained during the first half of the 1990s. Nevertheless, discussions between Geological Sciences and CAGE were conducted in 1995 to solve several problems that had developed between the two departments. It was decided that civil engineering students would take *Geology for Engineers* offered by CAGE instead of Geological Sciences' introductory course *Survey of Geology.* However, this course remained a requirement for geological engineering students. Almost ten years later, in 2004, *Geology for Engineers* was dropped by the Civil Engineering department and all civil engineering undergraduate majors were once again required to take *Survey of Geology.*

John Zellmer, the new director of the geological engineering program, was appointed Adjunct Professor of Geological Sciences and became available to chair geology M.S. committees for graduate students with a thesis having an environmental bent. In 1998 Professor Finney retired and in the same year Dr. Nick Lozano was hired as his replacement. Over the next several years, Geological Sciences worked with CAGE to modify the G EN curriculum. However, in 1999, CAGE announced that the G EN program would be shut down. Professor Lozano resigned in 2002 and the last B.S. degree in Geological Engineering was awarded in 2005. Dr. Zellmer resigned in 2006 to join an environmental/engineering consulting firm.

As the new millennium approached, the Department of Geological Sciences made significant progress in the area of research. This progress was facilitated by modification and reallocation of existing space and acquisition of new space for the department. Most of the rooms in the department were hard wired for the internet in 1993. In the spring of 1996, the department converted available office space in

Breland Hall to a sedimentary petrology research laboratory and the department's webpage was created in the same year. In the mid-1990s, Nancy McMillan acquired several used X-ray Fluorescence (XRF) spectrometers with the intention of building a XRF laboratory. The department did not have space in Breland Hall to house the newly acquired XRF equipment, but a moderate-size room was found in Milton Hall. This space was allotted to Geological Sciences to house the XRF laboratory. In addition, the department was given a small room in Milton Hall, which was used as a graduate student office. In 1999, a major reorganization of the department's laboratory facilities was undertaken. The department transferred its old ICP unit to the Department of Chemistry and Biochemistry. The old XRF spectrometers in Milton Hall were replaced with a new XRF analyzer. This instrument is currently part of Geological Sciences' AGRL facility housed in Gardner Hall.

An important milestone in the evolution of the department's research effort was the founding of the Institute of Tectonic Studies (ITS) through the inspiration and persistence of Kate Giles. The Institute of Tectonic Studies was established in 1998 as a consortium of academia and private corporations for the purpose of understanding tectonic processes and related structures, especially those with corresponding geological features of interest to oil and gas exploration companies. In the institute's first several years, funding from approximately 10 petroleum companies was obtained to support the consortium's work in the La Popa basin of northeast Mexico near Monterrey. As part of the Institute's obligation to its donors, ITS hosted an annual La Popa Basin conference and corresponding field trip that showcased the past year's research results for company representatives. These events not only highlighted, for these company representatives, some of the world class research conducted by the Department of Geological Sciences but also brought the department's graduate students in contact with potential employers. Over the course of the next thirteen years, the ITS was very successful in supporting not only the La Popa basin research, but also the research of faculty members and students working in other field areas.

Another research initiative called URGE (Undergraduate Research for Geologic Experience) was developed by Professor McMillan in 1999 to more effectively bring undergraduate students into the research culture of the department. This program formalized undergraduate research, an activity that was widely pursued by the faculty since the 1970s. This program continues today as an important component of the department's teaching-research activities. According to URGE's website description, *it is a group of undergraduate students who are working on original research projects under the mentorship of a faculty advisor or advisor from an outside organization, such as Los Alamos National Laboratory. The group, including Professor McMillan, normally meets once a week for lunch and members brainstorm research topics, grant proposals, and manuscripts, discuss progress in research projects, learn to use departmental equipment, and find ways to enhance the undergraduate research experience.* URGE continues to play a major role in the teaching and research missions of the department. To better integrate undergraduate research with writing skills, the department added a course beginning AY 2000-2001: GEOL 499 *Senior Thesis*.

While the above research developments were taking place, the department modified its curriculum to take advantage of new opportunities to develop courses in geophysics, geohydrology, and environmental geology. In the mid-1990s, Rick Huff (Ph.D., Louisiana State University, 1993), with the USGS branch office on campus, was appointed Adjunct Professor. Dr. Huff, a hydrogeologist with a geochemistry background, developed and taught courses in hydrogeology and environmental geology beginning in the spring 1996 semester. In time for the beginning of the 1996/1997 AY, the Department of Geography hired Daniel Dugas (Ph.D., University of Oregon, 1993) as Jerry Mueller's replacement. Responsibility was therefore passed to Professor Dugas for all undergraduate and graduate courses in geomorphology that geology majors took as a requirement or elective. In 1997, Professor Solomatov taught a graduate level geophysics course in geodynamics with an enrollment that was 90% geologists. In the following year, Professor Solomatov and Dr. Seager developed a junior level geophysics course designed especially for geology majors, GPHY 330 *Introduction to Geophysics*. This course was taught for the first time in the spring 1999 semester by Professor Solomatov. A course in petroleum/exploration geophysics was introduced for the first time in the fall of 1999; it was team taught at the senior/graduate level by Professors Lawton from Geological Sciences and Hearn from the geophysics program. These geology-geophysics courses continued to be taught until 2004 when major changes in the geophysics faculty began to take place.

The department had a significant personal change as the new millennium approached, William Seager retired at the end of the fall 1998 semester, after 33 years of service to the university community and the state of New Mexico. At the beginning of the fall 1999 semester, Jeffery Amato (Ph.D., Stanford University, 1995) joined the Geological Sciences faculty as William Seager's replacement. Professor Amato's expertise comprised the areas of geochronology, structural deformation, and tectonic evolution of igneous / metamorphic provinces. His teaching responsibilities included two core courses in the geology curriculum, *Structural Geology* and *Survey of Geology,* as well as courses in tectonics and field geology. While conducting ongoing studies of metamorphic core complexes in Alaska, Professor Amato invested time in developing a mineral separation laboratory to support his geochronology studies based on heavy isotope data. The department's hydrothermal lab was dismantled and the space allotted for construction of this mineral separation facility. In August of 2000, the department hired Marilyn Huff (M.S., Georgia Tech, 1985) as a geology instructor. She taught several *Survey of Geology* sections a semester for the department and was also hired by several NMSU branch campuses to teach the same course.

In the fall of 1999, the department was approached by the University Foundation to help with the dedication ceremony of the Zuhl Library and to assume responsibility for curation of the Herb and Joan Zuhl collection in Las Cruces. The collection consisted of more than 1000 specimens of petrified wood, fossils of vertebrae and non-vertebrae animals, including dinosaurs, as well as minerals and art objects made from minerals. These items were brought to Las Cruces by the Zuhls when they retired and moved to Las Cruces in 1991. To date, four department faculty/staff have been curators of the Zuhl collection: Professor Mack (1999 to 2006),

geology instructor Marilyn Huff (2006 to 2008), undergraduate student Matt Dawkins, as interim curator (2008 to 2012), and Tiffany Santos (M.A., New Mexico State University, 2010), who was hired in 2012 as fulltime director of the Zuhl collection on campus. Currently the collection is displayed in two main areas on campus: the Zuhl Library and the Zuhl Museum. The latter is housed adjacent to the NMSU Alumni and Visitors Center. The Zuhl collection has served to instruct and entertain not only the university community but also the community at large. While geology students have access to world class specimens of fossils and minerals to advance their academic studies, the general public has access to this university resource through museum visits, tours, educational programs, and various outreach events. Thus, the general public has the opportunity through this collection to learn about minerals, fossils, and the geologic history of the Earth.

In the early years of the new millennium, the Department of Geological Sciences continued to strengthen its position in teaching and research. The department expanded its teaching and research efforts to include Geographic Information Systems (GIS). In 2001, Dr. John Hawley completed work that involved department students using GIS techniques to modify and construct geologic maps. This research was funded by a WRRI grant administered through the Department of Geological Sciences. The WRRI's GIS expert at the time, John Kennedy (Ph.D., University of Texas, El Paso, 2004) taught a weekend college course *GIS Applications in Geology* for graduate students. The department's effort to focus on GIS applications in geology was halted in 2006 but has been recently renewed in 2015 with the introduction of an upper level undergraduate/graduate level course on GIS applications in geology.

By 2002, the department's graduate program and its overall research effort benefited greatly from the success of its faculty in obtaining support from the Petroleum Research Fund (PRF), National Science Foundation (NSF), and NMBMMR and the continued success of the Institute of Tectonic Studies. In addition to fostering cooperation between industry and the University, the institute also organized short courses on the geology and tectonics of salt-diapirs and courses on petroleum exploration for researchers in academia and industry. The research profile of Geological Sciences became fairly well defined by 2002, ten years after its founding. Three strengths dominated the profile: (1) local and regional field-oriented geologic studies in southern New Mexico and adjacent areas, including the making of geologic maps; (2) sedimentary petrology; and (3) analytical geochemistry. The department also had competency in the areas of igneous and metamorphic petrology and ore deposits. With regard to the first strength above, geology of New Mexico, the dominant players were professors Seager, Mack and Lawton. Professors McMillan, Giles, Amato, and Giordano also contributed to this effort. Almost from its founding, the department had a strong sedimentary geology program, comprising a carbonate (Giles) and two clastic (Mack and Lawton) sedimentary petrologists. The scope of the sedimentary geology program was expanded in the late 1990s, with the founding of the Institute of Tectonic Studies and its research of interest to petroleum geologists. With the arrival of Jeffery Amato, the department had two faculty members actively involved in the analysis of geologic materials. Professor Amato and his students separated minerals (primarily zircon) for analysis by using department facilities and equipment (e.g., the

Gemini mineral separation table) but they carried out their heavy isotope analyses in off-campus labs. Dr. McMillan and her students were able to use the department's sample preparation laboratories, X-ray diffractometer, and XRF spectrometer to chemically analyze many of their samples, but they also used equipment off-campus when necessary. Although the department's research activity expanded greatly over the first ten years of its existence, Geological Sciences remained remarkably stable in terms of regular faculty size and major enrollments. In Table 2, the department's fall 2000 profile is outlined and compared to its profile in the fall of 1992, the department's first semester. The profiles are similar, with significant changes only in the makeup of the faculty, number of degrees offered, and the number of adjuncts appointed. By the fall of 2000, the department offered two degrees: a Bachelor of Science degree in geology and a Master of Science degree in geology. The department had a faculty of six serving 26 undergraduate majors and 18 graduate students.

Table 2. Profiles of Geological Sciences (Fall 2000) and Geological Sciences (Fall 1992)

Department of Geological Sciences, Fall 2000

Faculty	Technical Staff	Degrees offered	U S M	G S M	T A
Amato	Hawley	B.S. in Geology	26	18	11
Giles	Huff, Rick	M.S. in Geology			
Giordano	Huff, Marilyn				
Lawton	Powers				
Mack	Witcher				
McMillan	Zellmer				

Department of Geological Sciences, Fall 1992

Faculty	Technical Staff	Degrees offered	U S M	G S M	T A
Giordano	Myers	B.S. in Geology	26	16	11
Gutierrez		Bachelor of Geological Sciences			
Lawton		M.S. in Geology			
Mack					
McMillan					
Seager					

USM = Undergraduate Student Majors
GSM = Graduate Student Majors
TA = Teaching Assistants

Department of Geological Sciences: 2003 - 2011

Over the course of the next eight years, 2003 through the spring of 2011, the Department of Geological Sciences experienced a series of important personnel and curriculum changes. Also, its research efforts shifted to strengthen further the analytical geochemistry focus of the department. In July of 2003, Professor Giordano returned to a regular faculty position after nine years at the department helm. Dr. Lawton took over as the third department head of Geological Sciences. Professor Lawton guided the department for the next four years, while teaching his regular set of courses in the areas of sedimentary geology, tectonics, and field geology and maintaining his research activities in Mexico, New Mexico, Utah, and Australia. At the end of the 2005 spring semester, the department offered for the first time a new senior-level course, *Geology Field Camp*. This month-long field camp was supervised by Professor Lawton with field areas in New Mexico and Utah. Dr. Giordano retired July 1st, 2006, after nearly thirty years of service as a member of the NMSU geoscience community. As a result of Dr. Giordano's retirement, the department had expertise vacancies in the areas of geochemistry and economic geology. Help in filling these gaps came later in July when a 1972 alumnus of the department, Michael L. Johnson and his wife Judy, presented $1 million to the department for the purpose of establishing the first endowed chair in the College of Arts and Sciences, the Michael Johnson Chair of Geochemistry (Fig. 11). In the fall of 2006, Professor Lawton initiated a search for Dr. Giordano's replacement and the department decided to award the Johnson Chair to the successful candidate. Also in 2006, the department's analytical geochemistry focus was broadened to include geologic applications of a relatively new micro-analytical technique, LIBS (Laser-Induced Breakdown Spectroscopy). This research effort was initiated by Professor McMillan and has evolved into the principal focus of her current research programI.

Figure 11. Timothy Lawton (left) and Michael Johnson, award ceremony, 2006 (New Mexico State University Department of Geological Sciences).

In August of 2007, Dr. Lawton resigned as head of Geological Sciences and the headship was passed to Nancy McMillan. By this time, discussions were already underway with architects on the renovation of Gardner Hall and the anticipated relocation of Geological Sciences to Gardner Hall. In addition to coordinating this project, Professor McMillan had to take care of several personnel matters. In November, she hired Lawrence Bothern (M.S., New Mexico State University, 2003) as an instructor, lab coordinator, and lab technician. She also continued the search for a geochemist to replace Dr. Giordano. In the following year, the department hired Frank Ramos (Ph.D., UCLA, 2000) to fill this vacancy in the area of geochemistry. Dr. Ramos left Central Washington University and joined the Geological Sciences faculty in time for the fall 2008 semester.

Professor Ramos, an isotope geochemist, had interests that ranged from developing new analytical techniques and establishing new applications for radiogenic isotopes to the investigation of how magmas form and evolve and the study of ages and evolution of ore deposits. The recruitment of Dr. Ramos dovetailed perfectly with the renovation of Gardner Hall. As the new Geological Sciences space in Gardner Hall was being planned, Professor Ramos was able to oversee the design of a clean lab and other labs housing the department's various analytical instruments. In addition to helping design the new analytical facilities in Gardner Hall, Professor Ramos moved his thermal ionization mass spectrometer (TIMS) from Central Washington University to NMSU. This instrument expanded the department's analytical capabilities to include the determination of Sr and Nd isotopic compositions of geologic materials and to carryout U isotope dilution analyses.

As the 2009/2010 AY proceeded, the department prepared for the anticipated move to Gardner Hall scheduled for the summer of 2010. Construction of the south wing of Gardner Hall was completed early in 1957 and the building originally housed the departments of Physics and Mathematical Sciences. The Graduate Physics Building (north wing of Gardner Hall) was completed in October of 1969. The Department of Physics was the sole occupant of Gardner Hall for over 35 years at the time of Geological Sciences' move into sections of the first floor and basement. The first floor of the north wing became completely occupied by Geological Sciences and housed the department office, faculty offices, microscopy classroom and lab, clean lab, rock preparation lab, analytical instrument laboratories, and computer lab. The first floor of the south wing housed classrooms, graduate student offices, a faculty office, structural geology lab, mineral separation lab, and sedimentology/stratigraphy lab. In the basement, Geological Sciences had several sedimentology/stratigraphy labs, a rock preparation lab, and a geochemistry laboratory. This space allocation and assignment is similar to the current space configuration. The Department of Geological Sciences gained about 7% more space than it had before the move and of course, it moved into a completely up to date facility. The Department of Physics currently shares space with Geological Sciences in the basement and first floor of the south wing. The offices and laboratories of the geophysics program have been housed on the third floor of Gardner Hall, since the program's inception in 1974.

Important curriculum changes were initiated with the start of the fall 2010 semester. From 1995 through early 2010, the Department of Geological Sciences offered one undergraduate B.S. degree in geology. Students majoring in geology could vary the direction of emphasis through the choice of course electives but department and non-department course requirements were the same, regardless of electives chosen. The 2010/2011 undergraduate course catalog introduced a Bachelor of Science in geology major with three options, each with their own set of department and non-department course requirements. This three-tiered curriculum is currently used by the Department of Geological Sciences. The option in Geological Sciences is the traditional geology degree offered by the department prior to AY 2010/2011. The second option, Earth and Environmental Systems, is a program of study that provides the scientific background for a career in environmental earth science, environmental policy, and resource management. The third option,

Earth Science Education, is a collaborative effort between the Department of Geological Sciences and the College of Education. In this option, students earn a Secondary Licensure along with a B.S. degree in geology. The Department's graduate program has not changed significantly over the years. The move to Gardner Hall brought the Department of Geological Sciences into close proximity with the geophysics faculty. However, since 2004, Geological Sciences' cooperation with the geophysics program had gradually weakened, as a result of faculty changes within the geophysics program.

In the first decade of the new millennium, the geophysics program underwent a series of important personnel changes. In August of 2003, the Department of Physics hired a fourth geophysicist, Boris Kiefer (Ph.D., University of Michigan, 2002). Dr. Kiefer's research focus was theoretical mineral physics, with applications in the study of materials comprising the Earth's mantle and core. In 2004, Kanani Lee (Ph.D., UC Berkeley, 2003) was hired as the department's fifth geophysicist. Professor Lee specialized in experimental mineral physics and focused on studies of mantle and core chemistry and phase equilibria. Although these mineral physics specialists brought the geophysics program more in tune with the material science interests of the Physics department, it became more difficult for the geophysics program to dovetail with the teaching and research interests of the Geological Sciences department. By the fall of 2011, the geophysics faculty had shrunk to two effective faculty members: professors Ni and Hearn. Dr. Kiefer remained in the Physics department but his interests shifted from geoscience to fuel and energy technologies. Professor Solomatov resigned in 2004 and joined the geoscience faculty at Washington University, while Professor Lee resigned in 2007 and joined the geoscience faculty of Yale University. In December of 2014, Professor Ni retired after serving the geophysics program at NMSU for thirty years. He remained active in research as a collaborator with Professor Hearn on the program's continued seismic study of the crust/mantle structure beneath the Tibetan Plateau. In 2015, the Physics department was poised to bring on board a replacement for Dr. Ni, not a seismologist but a geophysicist with expertise in the area of mineral physics.

In the fall of 2011, the Department of Geological Sciences commenced its twentieth academic year and, as they began the new semester, all geology majors and faculty members met the new face of the department, Gardner Hall. However, other than having a new home, the department had not significantly changed. A major transformation would take place over the course of the next three years but, at the beginning of the fall 2011 semester, the department looked stable in terms of faculty, enrollments of majors, curriculum, and research focus. A comparison of the department's fall 2000 profile with its profile at the beginning of the 2011/2012 AY is shown in Table 3. The data in this table highlight the apparent stability of the department in some categories but also show some significant changes over the eleven year period. In 2011, the department had two less technical staff, it lost two instructors (Rick and Marilyn Huff) and an adjunct professor (John Zellmer), and gained one additional staff member, Lawrence Bothern (instructor/lab technician). The number of B.S. degree options was increased from one in 2000 to three in 2011. During the eleven years from 2000 to 2011 the number of graduate students remained stable, usually between 17 and 23. The number of university funded TAs

remained constant at 11. A significant change in the undergraduate major enrollment took place in 2007, as the petroleum industry rebounded. The department's undergraduate geology major enrollment doubled by 2011, from 26 in the fall of 2000 to 53 in the fall of 2011. From 2000 through 2011, the department had six full-time faculty positions and throughout this period, only one faculty change took place; Frank Ramos replaced Thomas Giordano as the department's geochemist. This personnel change shifted the geochemistry focus of the department away from aqueous geochemistry and further in the direction of analytical geochemistry and the application of radiogenic isotopes in the areas of petrology and ore deposits. Aside from this shift, the department's research profile in 2011 was similar to its profile at the turn of the millennium.

Table 3. Profiles of Geological Sciences (Fall 2000) and Geological Sciences (Fall 2011)

Department of Geological Sciences, Fall 2000

Faculty	Technical Staff	Degrees offered	U S M	G S M	T A
Amato	Hawley	B.S. in Geology	26	18	11
Giles	Huff, Rick	M.S. in Geology			
Giordano	Huff, Marilyn				
Lawton	Powers				
Mack	Witcher				
McMillan	Zellmer				

Department of Geological Sciences (Fall 2011)

Faculty	Technical Staff	Degrees offered	U S M	G S M	T A
Amato	Bothern	B.S. in Geology	53	17	11
Giles	Hawley	Option in Geological Sciences			
Lawton	Powers	Option in Earth & Envir. Systems			
Mack	Witcher	Option in Earth Science Education			
McMillan		M.S. in Geology			
Ramos					

USM = Undergraduate Student Majors
GSM = Graduate Student Majors
TA = Teaching Assistants

Transformation Years: 2012 - 2015

After nearly twenty years of relative stability and gradual evolution, the Department of Geological Sciences underwent the first half of a major transformation in calendar year 2012. Kate Giles resigned as of January 1 to join the Geological Sciences faculty at the University of Texas, El Paso. The Institute of Tectonic Studies moved to UTEP with Professor Giles. Six months later, on July 1, professors Mack and Lawton retired after 32 and 26 years of service, respectively, to the NMSU community. To complicate matters further, Professor Amato had scheduled his sabbatical for AY 2012/2013. Although the department was prepared to handle its regular course load for the spring 2012 semester, the drastic and sudden reduction in faculty created a problem in covering courses from summer session 2012 through the summer of 2013. To cover most of the shortfall during this period, the department hired three temporary staff members. Amy Luther (Ph.D., New Mexico Tech, 2012), with expertise in structural geology, joined the faculty as a visiting assistant professor on a one year contract (from the fall of 2012 through the summer of 2013) to cover Dr. Amato's courses in structural geology and field geology. Angela Shankle (M.S., University of Wyoming, 2008) and Ginger Scarbrough (Ph.D., Purdue University, 1992) were hired as adjunct instructors to cover introductory geology courses from the summer of 2012 through the fall of 2013. In addition to these temporary staff, professors Mack and Lawton agreed to help with course coverage. Greg Mack taught one course during the fall 2012 semester, while doctors Mack and Lawton each taught a class during the spring 2013 semester.

By the fall of 2012, the department had permission to replace doctors Giles and Mack. The replacement of Dr. Lawton was postponed indefinitely, because of budgetary shortfalls within the University. The hiring process went smoothly and, in August 2013, the department brought on board, as replacements for professors Giles and Mack, Brian Hampton (Ph.D., Purdue University, 2006) from Michigan State and Reed Burgette (Ph.D., Oregon State University, 2008) from Oregon State. Reed Burgette's wife Emily Johnson (Ph.D., Oregon State University, 2008) was also hired by the department as a college assistant professor. Dr. Hampton, a sedimentologist, had expertise in clastic sedimentology/stratigraphy, tectonics, and basin analysis. His research approach was both field and lab based. Reed Burgette, a neotectonist, applied Quaternary dating techniques, GPS, and other geodetic techniques to study earthquake deformation, sea level fluctuation, and sea water – ice mass balance. Dr. Johnson specialized in igneous petrology/geochemistry and volcanology. Her research centered on magma formation and evolution as studied through field observation and melt inclusion chemistry. These three new faculty members allowed the department to start the fall 2013 semester with classes covered mostly by in-house faculty.

In addition to making progress in filling faculty positions in 2013, the department received good news in the summer from the National Science Foundation (NSF). After a five year effort on the part of Dr. Ramos and matching monies made available through the University and alumnus, Michael Johnson and his wife Judy, the NSF Major Research Instrumentation (MRI) program provided $500,000 towards the purchase of a new Multi-Collector Inductively Coupled Plasma Mass Spectrometer

(MC-ICPMS). Additional matching funds from the University and the Johnsons allowed the purchase of a laser ablation sampling system and the purchase of additional components that would allow the mass spectrometer to be fully equipped. The total price tag for the instrument purchased, a ThermoScientific Neptune Plus MC-ICPMS, came to approximately $1,000,000. Professor Ramos spent his non-teaching time during the remainder of the year through the summer of 2014, in preparing himself and the analytical laboratory for the fall 2014 arrival of the new Neptune MC-ICPMS.

After two years of turmoil mixed with elation, the calendar year 2014 was a welcome return to a more normal mode of operation. It was not only a new academic environment for the three new faculty members but it was, in fact, a transformed department for professors Amato, McMillan, and Ramos. In the fall 2013 semester, doctors Burgette, Hampton, and Johnson had the opportunity to become acclimated to New Mexico and the new university environment while developing new courses and carrying out ongoing research. Now they had the opportunity to concentrate on learning New Mexico geology and developing student research projects in southern New Mexico and adjacent areas. Dr. Amato continued with his post-sabbatical routine of teaching, graduate student advising, and writing papers on recent studies, as well as older studies, with data that had not yet been published. Professor Ramos took his sabbatical as planned during the 2014/2015 AY. The beginning of his sabbatical conveniently coincided with the arrival of the new Neptune MC-ICPMS in August of 2014. By mid-October installation was complete and Professor Ramos' team began performance testing and evaluations. Also in the fall, Wayne Marko (Ph.D., Texas Tech University, 2012) was hired as a visiting assistant professor to cover Frank Ramos' classes while he was on sabbatical. In addition to introductory geology, Dr. Marko taught courses in petrology, economic geology and geochemistry. The department added two new courses in 2014: a graduate level course *Geoscience Communication* and a course in volcanology. Under the direction of Dr. McMillan, the department began its first phase of the University's Academic Program Review. This initial stage took place in the fall and involved discussions of topics to be included in a *Self-Study Report* scheduled for completion in the spring of 2015 as part of the Academic Program Review.

The department went through the main part of the review process in November of 2015 when a review team, comprising three geologists from other universities and the Dean of NMSU's Honors College, visited the department. Their report, completed in 2016, starts with these words, as cited in the NMSU Department of Geological Sciences 2016 Newsletter:

"*The Department of Geological Sciences is a small vibrant program with faculty who are highly productive researchers and effective teachers. The program thus continues a strong tradition of field- and lab-based instruction and research with a focus on regional tectonics, geochemistry, and sedimentology. Undergraduate and graduate students praise the department chair and faculty for fostering a friendly and supportive culture while encouraging them in research and fostering their professional development. This program presents a model for success at New Mexico State University and other similar state universities*." The report is a glowing and supportive commentary

on the geology program at NMSU in its 125th year. As the fall 2015 semester came to a close, the Department of Geological Sciences had good reason to look with confidence towards the future. It survived a major transformation of its faculty and, at the same time, it survived funding restrictions from the University.

The department profile changed significantly from the end of 2011 to the Fall of 2015. These two profiles, which include emeritus professors, are compared in Table 4. The most critical change took place in the makeup of the faculty. The department's three senior sedimentologists (Giles, Lawton, and Mack) were replaced by a sedimentologist (Hampton), a neotectonist (Burgette), and a volcanologist (Johnson). Dr. Johnson was hired as a college assistant professor and not as a regular faculty member of the department, thus the department went from six regular faculty members in 2011 to five in 2015. The technical staff increased by one, Tiffany Santos, the Zuhl collection curator. The number of geology majors, both graduate students and undergraduate students, increased slightly but the

Table 4. Profiles of Geological Sciences (Fall 2015) and Geological Sciences (Fall 2011)

Department of Geological Sciences, Fall 2015

Faculty	Technical Staff	Degrees offered	U S M	G S M	T A
Amato	Bothern	B.S. in Geology	58	18	10
Burgette	Hawley	Option in Geological Sciences			
Hampton	Powers	Option in Earth & Envir. Systems			
McMillan	Santos	Option in Earth Science Education			
Ramos	Witcher	M.S. in Geology			
Johnson(1)					
Giordano(2)					
Lawton(2)					
Mack(2)					
Seager(2)					

Department of Geological Sciences, Fall 2011

Faculty	Technical Staff	Degrees offered	U S M	G S M	T A
Amato	Bothern	B.S. in Geology	53	17	11
Giles	Hawley	Option in Geological Sciences			
Lawton	Powers	Option in Earth & Envir. Systems			
Mack	Witcher	Option in Earth Science Education			
McMillan		M.S. in Geology			
Ramos					
Giordano(2)					
Seager(2)					

USM = Undergraduate Student Majors
GSM = Graduate Student Majors
TA = Teaching Assistants
(1) = College Assistant Professor
(2) = Emeritus Professor

number of university-funded teaching assistantships was reduced by one in 2014. The faculty change noted above resulted in a modification of the department's research profile. Although the areas of focus had not changed, shifts in emphases did take place. The tradition of focusing on New Mexico geology was taken seriously by the new faculty members and by the fall of 2015, all six professors had active research projects in New Mexico or were advising graduate students with field areas in New Mexico (see Appendix III). Several professors were advising undergraduate students working on research projects in New Mexico. During 2015, emeritus professors Mack and Seager also had active research projects underway in southern New Mexico.

Table 5. Analytical Geochemistry Research Laboratory

Sample Preparation
Rock Laboratory: Jaw crusher, shatterbox
Clean Laboratory
Geochemistry Laboratory
Gemini Table-- mineral separation
Franz Magnetic Separator--mineral separation
Heavy Liquids Separation--mineral separation

Analytical Instruments
X-ray Fluorescence (XRF) Analyzer
Laser Induced Breakdown Spectrometer (LIBS)
Thermal Ionization Mass Spectrometer (TIMS)
Multi-Collector Inductively Coupled Plasma Mass Spectrometer (MC-ICPMS)

In addition to ongoing research in New Mexico, the Geological Sciences faculty were active in other states and the following countries: Russia, China, and Kyrgyzstan. A summary of research progress by department faculty and students in areas outside of New Mexico, for the years 2015 and 2016, is given in Appendix IV. The department maintained a robust research effort in sedimentology, while expanding its research activities in the areas of tectonics (to include neotectonics), igneous petrology (in the direction of volcanology), and geochemistry (to include melt inclusion analysis and enhanced methods of analyzing heavy isotope compositions of geologic materials). With the arrival of the new Neptune MC-ICPMS, the department's analytical facility, AGRL, attained a new level of sophistication. A summary of instrument and sample preparation laboratories under the AGRL umbrella is given in Table 5.

The Geological Sciences faculty, from 2012 through 2015, have been successful in obtaining research funds from the National Science Foundation and other agencies that support academic research, including the New Mexico Bureau of Geology and Mineral Resources (NMBGMR), the United States Geological Survey, and the Southern California Earthquake Center (SCEC). Professor McMillan secured private as well as government funding to support her LIBS research projects. Of crucial importance to many of the department's geology majors has been the tens of thousands of dollars made available each year in scholarships and grants to cover general school expenses and research costs. This funding has come from a variety of sources, including department scholarships, grants to faculty, as well as scholarships and grants from the New Mexico Geological Society, the Geological Society of America, and other outside institutions. Finally, the Department of Geological Sciences has had many individual donors who supported, and continue to support, the department and its student scholarship and grant funds.

Legacy and Conclusion

The final chapter in this history is a description of the legacy left by one hundred and twenty-five years of geologic academic activity, as fostered by the Department of Geological Sciences and its predecessor departments and programs. The word legacy is usually associated with an individual. It comprises the important things produced by the individual that live on or that continue to influence society well into the future. An academic program also has a legacy. Two obvious legacies of NMSU's geology program are the Department of Geological Sciences and the geophysics program in the Department of Physics. They formed as the NMSU geology program evolved. However, the program's legacy is also reflected in its students, its research output, and its influence on individual citizens and society as a whole.

What can be said of the geology program's student legacy? As implied above, it consists of the program's contribution to its student's education, their productivity as professionals, their influence on society, and their development as persons. These categories are difficult to quantify. However, the number of students directly influenced by the NMSU geology program can be readily estimated and this number is a creditable metric of the program's student legacy. Although geology course enrollment data for the years prior to 1967 are either not available or not easily accessible, a good estimate can be established for the number of non-geology majors who have taken geology courses between 1890 and 2015: approximately 20,000 to 25,000. Most of these students took only one course, physical geology or one of the program's introductory geology courses, usually as a specific program or general education requirement or elective. Another approximately thousand non-geology majors took one or more geology courses beyond the introductory level. Of these thousand or so students, approximately one hundred were geology minors and the rest were predominantly from the following disciplines: civil engineering, geological engineering, agronomy, environmental science, earth science education, geophysics, and chemistry.

The number of geology majors that graduated from the program represents a dominant metric of the department's student legacy. Since the Bachelor degree was established in 1967, 381 Bachelor degrees in geology were awarded to NMSU students through 2015. The majority of these students were from New Mexico and entered the petroleum, mining, or environmental sectors of the economy in New Mexico and throughout the United States. Others became teachers or took jobs not related to the geosciences. Many of these 381 students obtained graduate degrees before settling down in their profession. In the 35 years from 1980 through 2015, the graduate program in geology produced 173 M.S. graduates. As with those who graduated with a Bachelor degree, most of these students took jobs in the extractive and environmental sectors of the economy, as employees in private industry, government, and academia. About 15% of these Master-level students entered Ph.D. programs. It should be noted that most of the graduate students recruited by the geology program came from out of state, and that many of these M.S. degree students pursued their professional careers in New Mexico.

Although much could be said about the contributions

to society these geology majors have made, it is sufficient here to point out those alumni who have been recognized for their high professional achievement. The Department of Geological Sciences has presented its Hall of Fame Award to an outstanding alumnus every year since 2006. The list of inductees from 2006 through 2019 is given in Table 6. These individuals are from many sectors of the geoscience job-spectrum and thus, this list illustrates the breadth of professional influence NMSU geology graduates have had and continue to have.

Among the important legacies of the geology program at NMSU, is its research contribution to our understanding of the geology of the state of New Mexico and other regions throughout the world. Since the mid-1960s, the geology program has produced, through the efforts of its faculty, graduate students, and undergraduate students, a vast amount of research that has led to a sophisticated understanding of the geology of southern New Mexico and adjacent areas. William King was the first geologist of the program to carry out a committed research effort. His research contributions were primarily focused in the areas of hydrology, stratigraphy, and petroleum potential. Although geologic research through the geology program began with Professor King, the most prolific and influential contributors to the body of geologic research pertaining to southern New Mexico were professors Seager, Mack, and Clemons. These geology faculty members were cited by the authors of a recent volume on the history of geological studies in New Mexico (Kues et al., 2014). They concentrated their efforts in studying the stratigraphy of southern New Mexico, the

Table 6 Department of Geological Sciences Hall of Fame Honorees

Year Inducted	Name of Honoree and Department Degree	Professional Position
2006	Michael Johnson (B.S., 1972)	General Manager of Conoco Gas and Power, a division of Conoco, Inc.
2007	Caitriona Keegan (B.S., 1984)	Keegan Geochemical Consultants AS, Stavanger Norway
2008	Glen Brown (M.S., 1982)	President of NELL Energy, Norman OK, gas exploration and production
2009	Peggy Johnson (B.S.,1979)	Department Head of Civil Engineering, Penn State University
2010	Ray Irwin (B.S., 1972)	Vice President of Exploration, Starfield Resources Inc., Toronto Canada
2011	Shari Alexander Kelly (B.S., 1979)	Senior Geophysicist and Field Geologist, NM Bureau of Geol. & Min. Res.
2012	James Witcher (B.S., 1977: M.S., 1994)	Witcher & Associates, Las Cruces NM, geothermal exploration & devel.
2013	Keith Rasmussen (M.S., 1982)	Retired, Senior Geologist and Geologic Mentor, Chesapeake Energy
2014	Danny Stokes (B.S., 1979)	Retired, Drilling Fluids Coordinator, Murphy Oil Corporation
2015	Robert Newcomer (M.S., 1984)	Program Leader, Golder Assoc., Albuquerque NM, environmental consult.
2016	Tinka Hyde (M.S., 1984)	Director of EPA Water Division, Great Lakes Region
2017	J. Paul Matheny (B.S., 1979)	Consultant, petroleum exploration, Steamboat Springs Colorado
2018	Joan Gardner (B.S., 1983)	Geologist, Naval Research Laboratory
2019	Jeffry Grigsby (M.S., 1984)	Professor of Geology, Ball State University

history of Laramide deformation and sedimentation, the formation and development of the southern Rio Grande rift, and the geologic evolution of the Basin and Range province in southern New Mexico and adjacent areas of Texas and Mexico. Professor Paul Morgan from the geophysics program collaborated with William Seager in studying the Rio Grande rift. Doctors Seager and Clemons also contributed to the understanding of the Cenozoic volcanic history of southern New Mexico and were major players in the identification of prominent volcanic features as representing calderas, maars, and ignimbrite fields. The investigation of the volcanic history of southern New Mexico was carried on by doctors McCurry and McMillan and more recently doctors Ramos, and Johnson.

In addition to his contributions mentioned above, Dr. Mack continued the work of Lee Gile in understanding paleosol development in southern New Mexico. Professor Mack, along with his collaborators and students investigated paleosols from Pennsylvanian- through late Cenozoic-age rocks using oxygen and carbon isotopes to estimate paleoclimates at the time of paleosol formation. Another long term project of Dr. Mack and his students was the study of the Permian system throughout the state of New Mexico. The understanding of carbonate systems in southern New Mexico was a focus of research for doctors King, Clemons, and Giles and their students. Professor Lawton and his students concentrated their research efforts in studying the tectonic, structural, and stratigraphic history of southwestern New Mexico and adjacent areas in Arizona and Mexico. His efforts were focused on rocks of the Mesozoic and Cenozoic Eras. Although professors Seager, Mack, and Clemons worked with Precambrian rocks in their study areas, Dr. Amato's efforts and those of his students were concentrated in studying prominent Precambrian features in southern New Mexico.

The geoscience program has also contributed to a better understanding of the economic geology in southern New Mexico. Doctors Seager and Clemons described ore deposits associated with volcanic centers in horst blocks of the Basin and Range of southern New Mexico. Professor Giordano and his students investigated similar deposits but also ore deposits associated with the Emery caldera of the Black Range and ores referred to as Rio Grande rift-related deposits. The hydrogeology of the Mesilla Bolson and Doña Ana County was studied by William King, as mentioned above, and John Hawley. In addition to the LIBS technology being used by Dr. McMillan and her students in sedimentary provenance studies and other geologic applications, she and her students have been successful in applying the LIBS analytical technique in the areas of anthropology, provenance studies of conflict minerals, and quality control of highway aggregate. With regard to the department's newest faculty members, the research legacy of the geology program should be advanced in the areas of neotectonics and sedimentology through the efforts of professors Burgette and Hampton, respectively.

The geophysics program, while associated with the geology program at NMSU and under the direction of Professor Chandler Swanberg, conducted an extensive reconnaissance study of the geothermal resources of Mew Mexico, with a particular focus on geothermal resources in the southern Rio Grande rift. The geophysics and geological engineering programs worked with NMSU's Physical Science Laboratory to develop geothermal energy utilization on the

NMSU campus. This work was subsequently carried on by the Southwest Technology Development Institute on campus, under the direction of James Witcher (see Appendix II).

In addition to the above studies pertaining directly to New Mexico, the faculty of the geology program and their students have conducted research in several other states including Utah, Arizona, California, Alaska, Washington, Oregon, and Michigan; and in several other countries, including Guatemala, Mexico, Russia, Greece, Australia, China, and Kyrgyzstan. The geophysics program, while associated with the geology program in the Department of Earth Sciences, conducted geothermal studies in most western states as well as Egypt. Paul Morgan from the geophysics program, with colleagues and students conducted studies on the geothermal resources, geologic evolution, and geodynamics of the East African rift in Kenya and other countries of eastern Africa.

Most of the research legacy described above is field-based, involving measurements, observations, and samples taken from the field. However, the bulk of the program's research legacy from Professor Giordano is either laboratory-based (measurements, observations, and samples taken from laboratory experiments) or derived from theoretical models based on thermodynamic data of geologic materials and literature-based field data from specific sedimentary aquifer systems. His laboratory investigations have advanced the thermodynamic data base for aqueous species responsible for the transport of lead, zinc, and other metals in hydrothermal systems, particularly those containing dissolved organic matter. His theoretical models of speciation in hydrothermal fluids have advanced the understanding of metal transport in oil-field brines and related ore fluids. In addition to Professor Giordano's laboratory work, doctors McMillan and Ramos have developed various laboratory techniques for analyzing geologic materials and have expanded the scope of applications for which specific analytical techniques can be used.

It should be mentioned that much of the above geologic research was published in various main-stream academic journals, publications of the state of New Mexico (NMBGMR), and publications available through the New Mexico Geological Society. A significant amount of data has been published in geologic map form by the NMBGMR. Also, many of these investigations have been brought together in the form of annual fall field trips and the associated Fall Field Conference guidebooks published by the New Mexico Geological Society. The faculty and students of NMSU's geology program have been very active in the organization and running these field trips and nine faculty members have served as an editor for one or more of the guidebooks. Special recognition should be given to Greg Mack for his contribution to this series of field trips and guidebooks. Dr. Mack also collaborated with Professor Giles in editing a monograph on the geologic history of New Mexico (Mack and Giles, 2004). Professor Swanberg, his students, and collaborators put to print much of their geothermal research in publications of the USGS, Geothermal Research Council, and state of New Mexico, including the WRRI.

In conclusion, the history presented above documents the development of a single discipline, geology, within the context of NMSU's growth from a small agriculture college in 1890 to a modern state

university 125 years later. It is hoped, that through a better understanding of the geology program's academic evolution, the program's alumni and current students, faculty, and staff will have a more profound appreciation of their academic experience at New Mexico State University. This history also highlights the importance of the geology program to NMSU's overall mission of teaching, research and service. Furthermore, the story underscores the current contribution of the Department of Geological Sciences in helping NMSU to fulfill its role as a land-grant university.

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Appendix I:
Geology Majors

The geosciences job market has traditionally underpinned undergraduate geology-major enrollment throughout the United States. The relationship between job market and graduate student enrollment is a bit more complex. That said, all sectors of the geosciences job market were in a boom phase throughout most of the 1970s, a geoscience-job bubble in today's parlance. However, by the early 1980s, petroleum and metal-mining companies began to downsize their geoscience workforce as a result of various economic factors, including a drop in commodity prices and the imposition of a federal windfall profit tax. Hiring in the environmental, water resources, and industrial rock and mineral areas continued to climb but this positive pace of hiring could not make up for the slowdown in the petroleum and metal-mining sectors. At NMSU, enrollments of geology undergraduate majors peaked during the 1981/1982 AY at 119 and began to decline rapidly over the next five years in response to the worsening job market in the petroleum and metal-mining sectors (see Appendix I, Figure 1). Enrollments of M.S. geology majors saw an increase throughout the same period; 6 to 35 from AY 1980/1981 to AY 1985/1986. This increase was the result of the newness of the M.S. program and because in downturns of this nature, where job offers are scares, larger numbers of students with a Bachelor degree in geology apply to graduate school. By the early 1990s and for the next ten years, undergraduate enrollments leveled off and hovered between 25 and 30. Throughout this period graduate enrollments remained steady at about 20.

At the end of the 2001/2002 AY, undergraduate enrollments dropped to 20. From that point on enrollments gradually increased over the course of the decade. Around 2005, the petroleum industry in the United States significantly increased its hiring of graduate- and undergraduate-level geology students to fill positions opened by retiring staff and to manage the new exploration opportunities brought about by technology advances, particularly fracking combined with horizontal drilling and 3-D modelling of prospective fields. As a result of the petroleum industry's upturn, undergraduate enrollments in the department doubled from 26 in 2000 to 53 in 2011. A plateau, averaging about 55, was reached by 2012 and undergraduate geology enrollments remained fairly steady, at this level through 2015. Graduate student enrollments, which were relatively constant, between 20 and 25 since the inception of the program, began to decline in 2012 with the loss of ITS and a reduction in the department's TA allotment from 11 to 10 in 2014. However, graduate student enrollments rebounded a bit and stabilized in the range of 15 to 20.

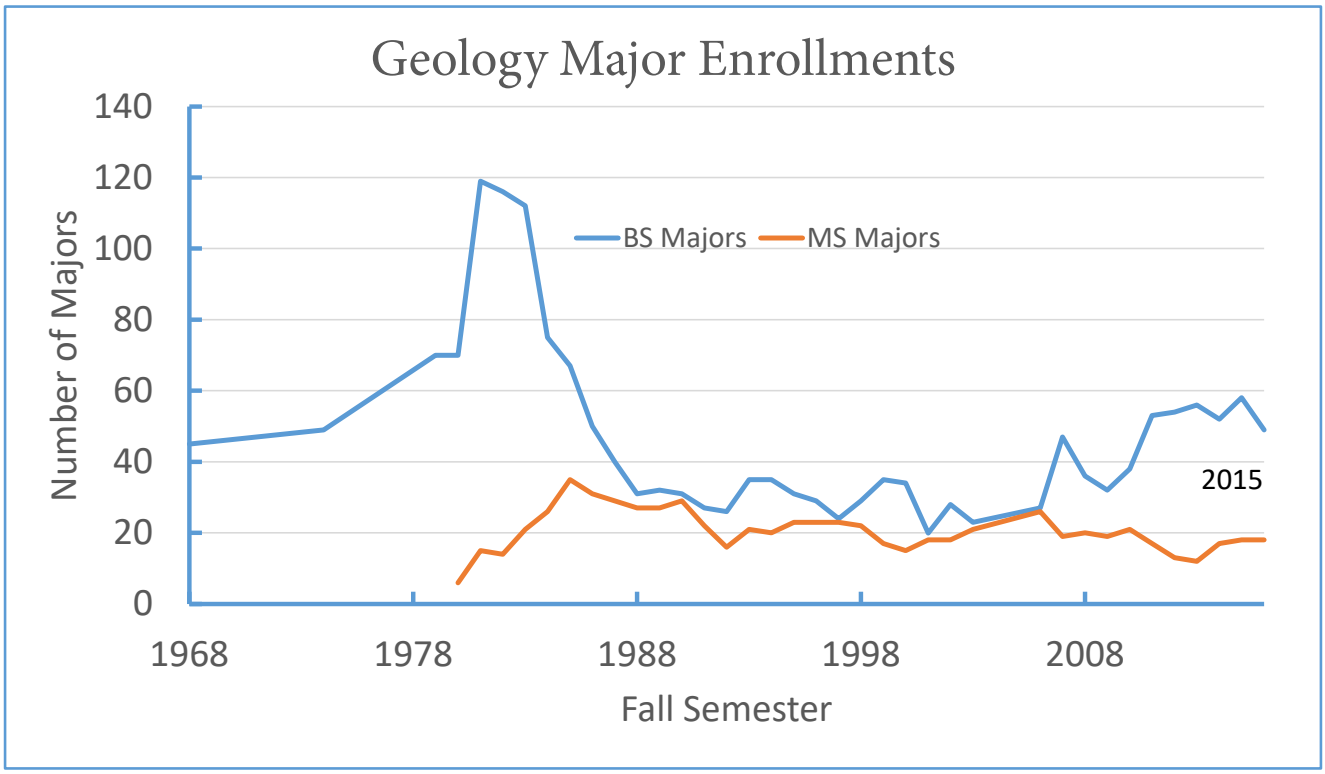


Figure 1. New Mexico State University BS and MS geology enrollments from 1968 to 2015

Appendix II: Geothermal Program

Initial research efforts of the geophysics faculty and their graduate students focused on geothermal resource evaluation and exploration. This focus was established with the arrival of Professor Swanberg and continued for the next ten years. From 1974 through 1984 the geophysics program secured over five million dollars in research grants to conduct exploration and evaluation of geothermal resources in Egypt and nearly all of the western states of the U.S. In Dona Ana County, NM, this research centered on identifying and developing viable geothermal resources suitable for direct heating on the NMSU campus in Las Cruces. The design for this heating system was conducted by the Physical Science Laboratory on the NMSU campus, while well drilling and development were initially directed by Professor Chaturvedi through the College of Engineering. These latter projects were carried out for the most part in cooperation with the NM Energy Research and Development Institute, the NM Energy Institute and its successors on campus: the NMSU Energy Institute and Southwest Technology Development Institute (STDI). Funding for the above geothermal projects came, for the most part, from the Department of Energy (DOE), the United States Geological Survey and the NM Energy, Minerals, and Natural Resources Department. Geothermal research through the geophysics program ended in 1984 with the resignation of Professor Swanberg. New Mexico State University closed its geothermal system in the 2002, however geothermal research continued on campus through the STDI until 2006 when the geothermal program of the institute was ended. After leaving the STDI in 2006, the institute's sole geothermal staff scientist James Witcher (M.S., New Mexico State University, 1994) has continued, as a private consultant, to conduct geothermal exploration and development projects throughout New Mexico and neighboring states.

Appendix III:
2015 - 2016 Research Projects in New Mexico

Selected 2015/2016 research projects, with field areas in the state of New Mexico, conducted by the faculty and students of the NMSU Department of Geological Sciences

- History of the Schoolhouse Mountain caldera in the Burro Mountains of the Mogollon – Datil volcanic field
- Proterozoic geology of southern New Mexico
- Uplift history of the Rio Grande Rift and adjacent Basin and Range
- Tuffs and lava flows associated with the Laramide orogeny
- Provenance study from Upper Cretaceous strata of the Sevier foreland basin in southern New Mexico
- Middle Eocene volcanogenic/volcanoclastic strata of the Palm Park Formation in southern New Mexico
- Provenance and sediment dispersal studies of the Early Permian non-marine strata of the Abo Formation in southern New Mexico
- Melt volatile compositions, melt evolution, and storage depths from the Organ Caldera ignimbrites
- Geochemical and isotopic variations of the alkali-rich Bandera basalt from the Zuni-Bandera volcanic field near Grants, New Mexico
- Melt inclusions from the Raton-Clayton volcanic field, northwest New Mexico
- Study of melt inclusions from the Doña Ana Mountains in southern New Mexico
- Geology of the Prehistoric Trackways National Monument, Robledo Mountains, southern New Mexico
- Proterozoic geology of the San Andres Mountains, New Mexico
- Pre-eruptive storage conditions of the magmas erupted from the Organ Caldera, southern New Mexico
- Use of backpack LIBS to distinguish between bacterially-influenced calcite and inorganically crystallized calcite in caves in the Carlsbad, NM area
- Lava flows of the Taos Plateau volcanic field
- The use of LIBS to study provenance of gem stones
- The use of LIBS in quality control of highway aggregates
- Geology of the Palomas Gap quadrangle, New Mexico
- Remapping the Doña Ana Mountains
- Upper Cretaceous sequence stratigraphy in southern New Mexico
- Sequence stratigraphy of Permian carbonates in the Robledo Mountains of southern New Mexico

Appendix IV:
2015-2016 Research Projects Outside New Mexico

Selected 2015/2016 research projects, with field areas outside of New Mexico, conducted by the faculty and students of the NMSU Department of Geological Sciences

- Rate of land level and sea level change along the west coast of the US
- Study of the western Transverse Ranges of southern California
- Provenance studies of the Paleozoic strata from the Michigan basin as well as Meso-Neoproterozoic strata in the Midcontinent Rift
- Subduction contribution to mafic magmas in the southern Cascade arc
- Changing eruption styles of the Blue Lake maar crater in central Oregon
- Studies of the Changbaishan lavas, China
- Study of active mountain building in the Tien shan Mountains of Kyrgyzstan, central Asia
- Study of the Silurian-Devonian strata of the Farewell terrane in southwestern Alaska
- Mesozoic tectonic development of the South Anyui suture zone in eastern Russia
- Study of volatile content of glasses from a submarine explosive eruption in the Izu-Bonin Mariana arc

References

Beebe, H., 1988, Astronomy, in New Mexico State University College of Arts and Sciences Centennial History, ed. by Billington, M.: College of Arts and Sciences Centennial Committee, pp. 24-35.

Campbell, C. L., 2009, A history of the Geography department at New Mexico State University: Southwestern Geographer, v.13, pp. 89-101.

Hawley, J.W., 2005, Five million years of landscape evolution in New Mexico: an overview based on two centuries of geomorphic conceptual-model development, in New Mexico's Ice Ages, ed. by Lucas, S. G., Morgan, G. S., and Zeigler, K. E.: New Mexico Museum of Natural History and Sciences Bulletin No. 28, 300+ pp.

Hughes, J.M. (ed.), 2013, Aggie Panorama, New Mexico State University Alumni Magazine: New Mexico State University, v. 62, 36 pp.

King, W., 1988, Earth Sciences, in New Mexico State University College of Arts and Sciences Centennial History, ed. by Billington, M.: College of Arts and Sciences Centennial Committee, pp. 77-81.

Kropp, S. F., 1972, That all may learn, New Mexico State University, 1888-1964: New Mexico State University, 401 pp.

Kues, B. S., Lewis, C. L., and Lueth, V. W., eds., 2014, A brief history of geological studies in New Mexico: New Mexico Geological Society Special Publication 12, 230 pp.

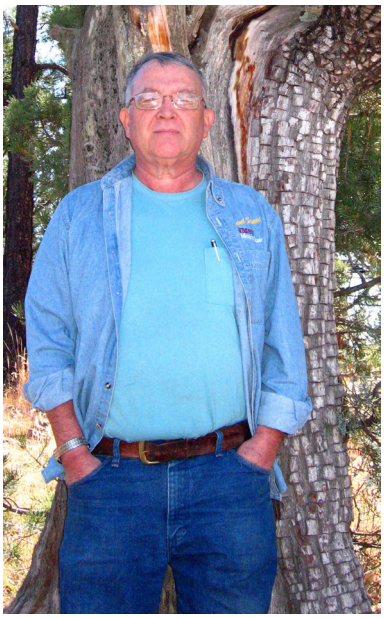
Liefeld, R. and Radziemski, L., 1988, Physics, in New Mexico State University College of Arts and Sciences Centennial History, ed. by Billington, M.: College of Arts and Sciences Centennial Committee, pp. 159-165.

Mack, G. and Giles, K. A., eds., 2004, The Geology of New Mexico, A geologic history: New Mexico Geological Society Special Publication 11, 474 pp.

Seager, W. R., 1989, Brief history of the Department of Earth Sciences at New Mexico State University: New Mexico Geology, v.13, no. 4, pp. 84.

Stucky, H. R, 1979, A History of the New Mexico Water Resources Research Institute, New Mexico State University, 1963-1978: New Mexico Water Resources Research Institute, 55+ pp.

About the Author



Author Tom Giordano

Thomas H. Giordano spent his early, primary school years in Philadelphia, Pennsylvania, where he was born in 1950. He completed his primary and secondary schooling in Lancaster, PA and received a bachelor degree in chemistry from Millersville State College, PA (now Millersville University). He obtained his Ph.D. in geochemistry from Pennsylvania State University, where his dissertation research focused on the experimental determination of thermodynamic properties of lead species in hydrothermal solutions and the modelling of lead transport and deposition in sediment-hosted hydrothermal lead-zinc deposits. In 1977 he obtained a post-doctoral position in the geophysics program at New Mexico State University. In this position, he worked on several geothermal exploration projects, before joining the geology faculty at NMSU in 1980. For twenty eight years he taught courses, at NMSU, in geochemistry, petrology, ore deposits, and introductory geology. He and his students conducted research in several areas including investigations of mineral deposits in southern New Mexico, experimental/theoretical investigations of metal transport in oil-field brines and related ore-forming fluids, and the role of organic matter in the formation of ore deposits. From 1994 to 2003 he served as Head of the Geological Sciences department and has been an Emeritus Professor in that department since 2006. In 2015 he moved from Las Cruces, NM to the Pocono Plateau region of northeastern Pennsylvania, where he now resides.

The history behind the Department of Geological Sciences at New Mexico State University goes back one hundred and thirty years and is complex. This history, as told in the pages of this monograph, documents the important details behind the founding of the NMSU geology program and its growth and evolution to 2015. The program's history is conveniently divided into three administrative phases. Phase I comprises the first 55 years, during which the program's activities were managed by one or two regular academic departments of the University. In the Earth Sciences phase, the geology program was administered as a division, along with one or two other divisions in the same department. In its third phase, the geology program became a regular academic department within the College of Arts and Sciences, its current status as the Department of Geological Sciences. Two obvious legacies of NMSU's geology program are the Department of Geological Sciences and the geophysics program in the Department of Physics. However, the program's legacy is also reflected in the students who have taken its courses and the program's research output through the efforts of its faculty, graduate students, and undergraduate students. Since the mid-1960s, the geology program has produced a vast amount of research that has led to a sophisticated understanding of the geology of southern New Mexico and adjacent areas. Finally, through a better understanding of the geology program's academic evolution, the program's alumni and current students, faculty, and staff will have a more profound appreciation of their academic experience at New Mexico State University.