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Jeffrey A. Grambling

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PRECAMBRIAN GEOLOGY OF THE TRUCHAS PEAKS REGION, NORTH-CENTRAL NEW MEXICO, AND SOME REGIONAL IMPLICATIONS

JEFFREY A. GRAMBLING*
Department of Geological and Geophysical Sciences
Princeton University
Princeton, New Jersey 08544

INTRODUCTION

A complexly folded sequence of Precambrian metamorphic rocks is exposed along the crest of the Truchas Range, a 5 x 10 km area extending from Pecos Baldy to North Truchas Peak in the Sangre de Cristo Mountains, 30 km northeast of Santa Fe (fig. 1). Stratigraphic and sedimentary features of the rocks have been preserved through folding and middle amphibolite-facies metamorphism. Lithologies are broadly correlative to those in the nearby Picuris Range, 30 km northwest of Truchas Peak, as noted by Montgomery (Miller and others, 1963), but the stratigraphy of the Truchas Range is complicated by abrupt lateral facies changes and differential metamorphism.

Stratigraphic, structural and metamorphic evidence supports a unique reconstruction of the Truchas and Picuris terranes prior to offset along the Picuris-Pecos fault, as Montgomery initially suggested (Miller and others, 1963). The pre-faulted terrane consists of a massive accumulation of quartzite at its north end and a thick succession of metavolcanic and metasedimentary rocks at its south end (see also Robertson and Moench, this guidebook). Key sedimentary facies changes, reflecting variation from shallow-water platform sedimentation in the north to deeper-water basin deposition in the south, are preserved in the Precambrian stratigraphy of the Truchas Range. When reassembled with metamorphic rocks of the Picuris Range and of the Pecos greenstone belt (south of the Truchas Range; Robertson and Moench, this guidebook), rocks of the Truchas Range indicate that deposition of quartzite along a mid-Proterozoic continental margin was occurring simultaneously with volcanism and sedimentation in a rapidly subsiding basin, possibly rifted, farther south.

GENERAL GEOLOGY

The Truchas Peak area forms part of a mountainous uplift of metamorphic, granitic and sedimentary rocks flanking the east side of the Rio Grande valley in north-central New Mexico. Most of the western part of the uplift consists of a complex Precambrian granitic batholith, termed the Embudo granite by Montgomery (Miller and others, 1963). A major north-south fault forms the eastern boundary of the granitic terrane, with Precambrian metamorphic and Paleozoic sedimentary rocks in contact with the Embudo granite along this fault.

Metamorphic rocks are exposed in a fault block of probable Laramide age around Truchas Peak. The rocks were affected by two folding events which occurred concurrently with metamorphism, and record evidence of Precambrian as well as pre-Mississippian faulting. No dating has been done on rocks of the Truchas Peak area, but Robertson and Moench (this guidebook) estimate depositional ages of 1 700-1 800 Ma for metavolcanic rocks of the Pecos River area, believed to be correlative with some of the rocks mapped in this study, and 1425 Ma has been interpreted as the age of metamorphism in the Picuris Range (Gresens, 1975) and Tusas Mountains (Long, 1972).

The metamorphic basement is overlain unconformably by a Paleozoic sedimentary cover. The unconformity seems to be undisturbed where it is exposed south of Pecos Baldy, but much of the Precambrian-Paleozoic contact in the Truchas Range now occurs along high-angle reverse faults. Paleozoic lithologies are described by Sutherland (Miller and others, 1963).

This report is based on the results of 1:12,000 mapping done during the summers of 1976, 1977 and 1978.

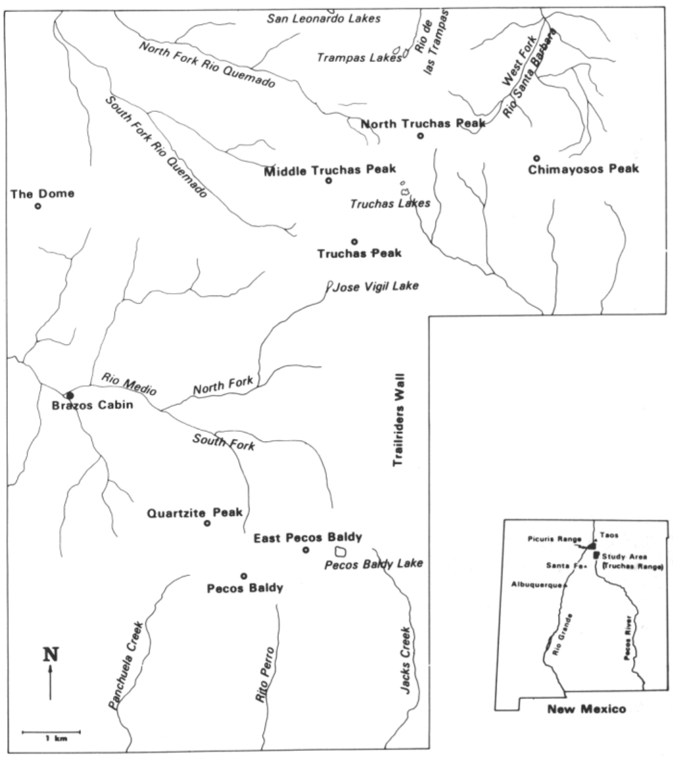

Figure 1. Location map. Inset shows location of the Truchas Range relative to the Picuris Range and the Pecos River (see Robertson and Moench, this guidebook).

*Present address: School of Geology and Geophysics; The University of Oklahoma; 830 Van Vleet Oval; Norman, Oklahoma 73019.

PRECAMBRIAN STRATIGRAPHY

The stratigraphic nomenclature used in this paper has been adapted, with minor changes, from that developed for the Picuris Mountains (Long, 1976; Montgomery, 1953; Nielsen, 1972). All metasedimentary rocks are considered to be part of the Truchas Group, defined as a mid-Proterozoic metasedimentary succession composed mostly of recurrent horizons of quartzite. The Truchas Group may be equivalent to other quartzite terranes exposed throughout north-central New Mexico (see Foster and Stipp, 1961).

Exposures of the Truchas Group in the Truchas Range consist of four horizons of massive quartzite interspersed with lesser amounts of metashale and metavolcanic material. The stratigraphic sequence can be divided into the basal Ortega quartzite, overlain, in turn, by the Rinconada Formation which includes a quartzite member, the Marquenas quartzite, the Vadito Formation, and the Truchas quartzite. The complete stratigraphic section is illustrated in Figure 2.

Ortega Quartzite

The Ortega quartzite is a massive unit which crops out at the centers of several anticlines (fig. 3). It has a minimum thickness of 1000 m, but its base is not exposed. The quartzite is variably white, tan or gray, and consists of 95-100% quartz with accessory amounts of muscovite, tourmaline, rutile, hematite, ilmenite, zircon and rare aluminous silicates. Certain bedding horizons, 1-2 cm thick, are rich in Al_2SiO_5 minerals together with local chloritoid or staurolite grains. Commonly, the quartzite is crossbedded, with bedding planes defined by concentrations of opaque minerals. Crossbeds have proven to be useful indicators of the stratigraphic "up" direction.

Montgomery (Miller and others, 1963) mapped a number of 10-20-m-thick sillimanite or kyanite schist layers as part of the Ortega quartzite. My work has shown that most of these layers are lateral facies variants of the overlying Rinconada Formation and are not part of the basal Ortega quartzite.

Rinconada Formation

Overlying the Ortega quartzite is a series of pelitic units interbedded with quartzite, called the Rinconada Formation. The most complete section of Rinconada rocks is exposed in a syncline 2 km west of Pecos Baldy. Here, all members of the formation can be seen: the lower pelitic member, the Rinconada quartzite, the upper pelitic member, the Pilar phyllite and the Piedra Lumbre (pelitic) member (fig. 2). Metapelite is the most abundant rock type; all three pelitic members are lithologically similar. Units show graded bedding and small-scale scour and fill structures, reflecting their apparent turbidtic nature. The rocks are metamorphosed variably: individual layers can be followed along strike as they change from fine-grained phyllites to coarse-grained porphyroblastic schists. All rocks contain quartz and muscovite together with traces of graphite, and most have minor amounts of plagioclase, tourmaline, ilmenite, several Fe-Mg silicates, and at the highest metamorphic grade, andalusite. Chemical analyses (Grambling, in prep.) show that the pelitic units west of Pecos Baldy are compositionally equivalent to average shales.

The Rinconada Formation includes two nonpelitic members: the Rinconada quartzite and the Pilar phyllite. The quartzite outcrops as a 10-50-m-thick continuous bed of black to white glassy metaquartzite. It differs from the Ortega quartzite by containing magnetite rather than hematite and by

Formation	Member	Lithology	Thickness, m.
Truchas Quartzite		Massive quartzite	At least 200
Vadito	Jose Vigil	Interbedded metavolcanic and metasedimentary material	25-250
	Little South Truchas Quartzite	Massive quartzite	0-250
	Cañoncito Rail	Interbedded metavolcanic and metasedimentary material	100-200
Marquenas Quartzite		Massive quartzite	200-350
Rinconada	Piedra Lumbre	Pelitic unit outcropping at variable metamorphic grade	0-60
	Pilar Phyllite	Gray-black graphitic quartz-muscovite phyllite	0-200
	Upper Pelite	Pelitic to highly aluminous unit outcropping at variable metamorphic grades	0-75
	Rinconada Quartzite	Massive quartzite	5-200
	Lower Pelite	Pelitic to highly aluminous unit outcropping at various metamorphic grades	0-50
Ortega Quartzite		Massive quartzite with minor interbedded aluminous schist	At least 1080

Figure 2. Generalized stratigraphic section for Precambrian rocks of the Truchas Peaks area.

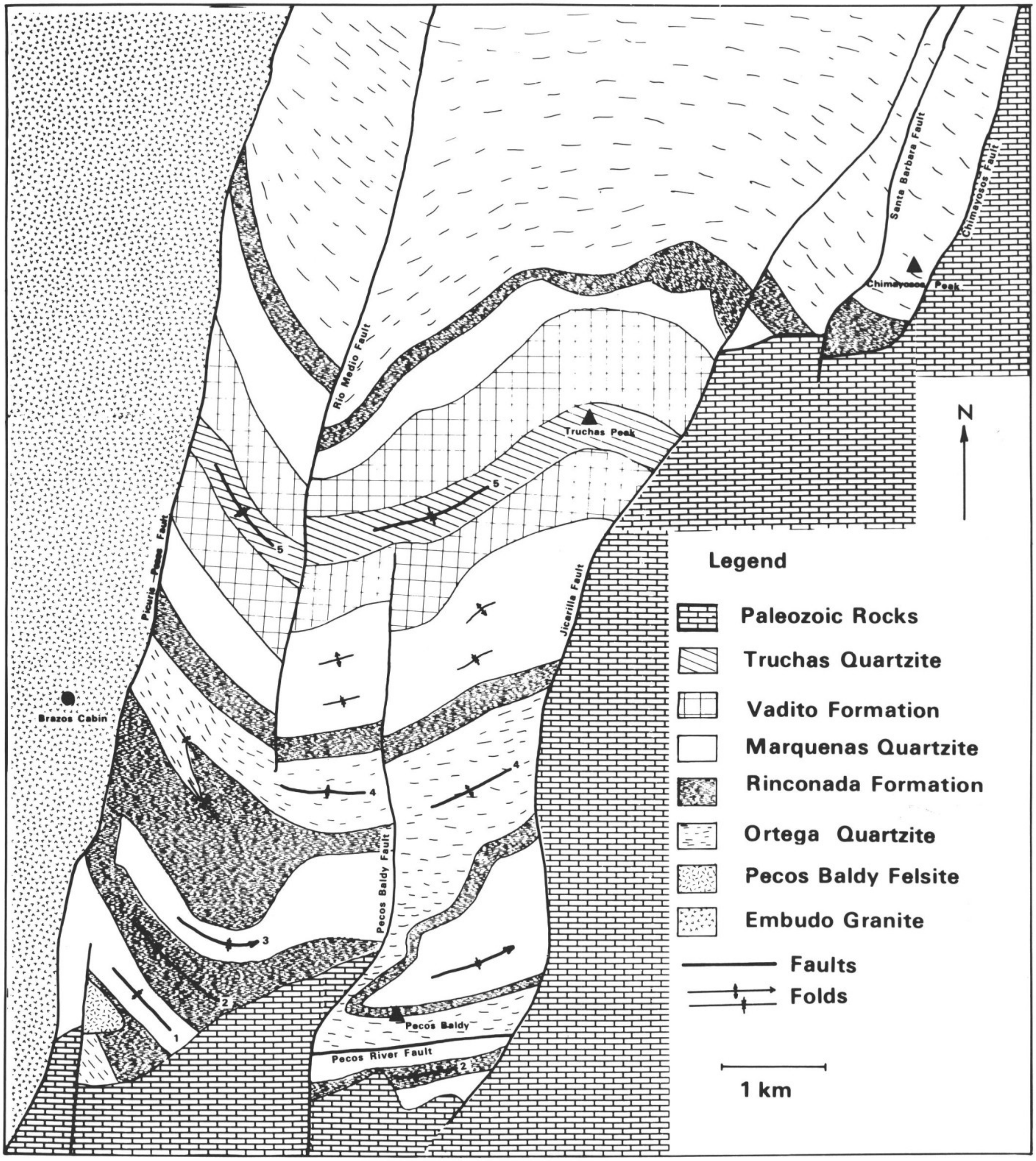

Figure 3. Generalized geologic map of the Truchas Peaks area. Folds referred to in text: 3 = Quartzite Peak syncline, 5 = Truchas syncline.

the presence of widely dispersed beds of phyllite or schist, several centimeters thick, which are graded internally. The Pilar phyllite, a jet-black slaty rock, is composed mostly of quartz, muscovite and traces of biotite, but contains abundant disseminated carbonaceous material. Carbon (as graphite) is so abundant that even thin sections of this rock are black. The unit is exceedingly fine-grained; quartz and foliated muscovite crystals rarely exceed .03 mm in size.

As units of the Rinconada Formation are followed north through a series of isoclinal folds, all beds change in thickness and composition. The Pilar phyllite thins and disappears; the upper pelite and Piedra Lumbre horizons become indistinguishable from one another, and the Rinconada Formation only can be divided into two pelitic units separated by a quartzite (fig. 4). The Rinconada quartzite becomes much thicker, up to 200 m, hematitic, crossbedded and virtually identical in appearance to the basal Ortega quartzite. Pelitic units thin and become volumetrically subordinate to quartzite within the formation. In a few places, the pelitic horizons pinch out entirely. They do so gradationally, merging along strike into aluminous quartzites and then into pure quartzites. The graded bedding, abundant west of Pecos Baldy, gives way to a massive or banded texture north of Quartzite Peak; porphyroblastic schistose layers become more gneissic toward the north. The mineralogy of the schist changes to one dominated by kyanite or sillimanite, quartz, hematite and minor muscovite. The change

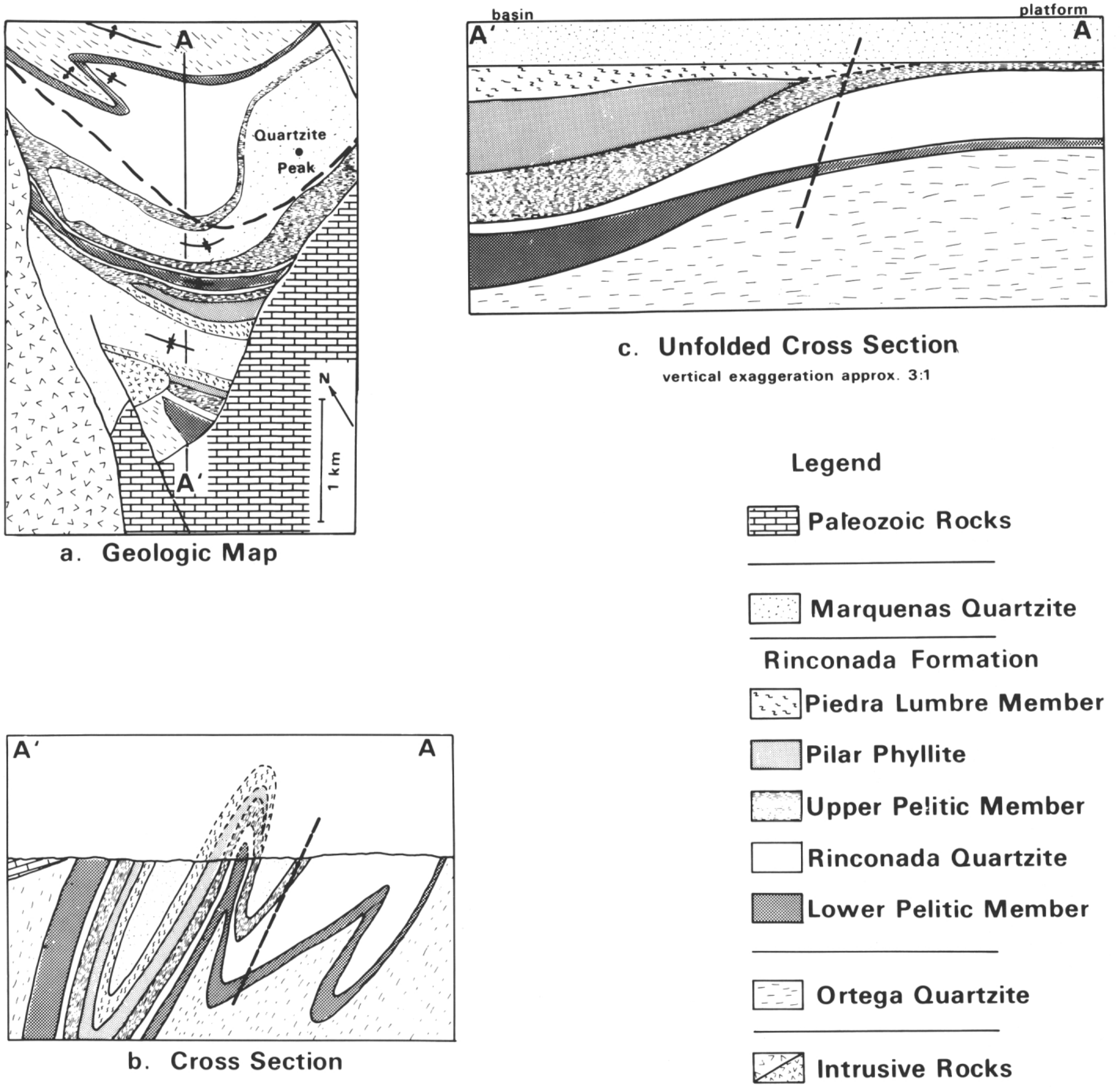

Figure 4. Detail of the region south of Quartzite Peak and west of Pecos Baldy. Heavy dashed lines: approximate location of sedimentary facies transition zone (see text).

in mineralogy is gradual and can be followed in outcrop in the upper peke member in the north limb of the syncline centered on Quartzite Peak. Mineralogic changes reflect the changing chemistry of the horizons: from south to north, the Al203 content of the pelitic rocks increases from 16 to 27 weight %, their total alkali content drops from 5 to 1 weight %, and iron changes from primarily ferrous to primarily ferric.

Changes in the nature of the Rinconada Formation, occurring from south to north, appear to preserve facies changes in the sedimentary protoliths of the rocks. These changes occur in a transitional zone centered around Quartzite Peak and shown in Figure 4.

Marquenas Quartzite

Conformably overlying the Rinconada Formation is a horizon of massive quartzite. In northern outcrops, this unit is lithologically identical to the basal Ortega quartzite, a white to gray crossbedded hematitic unit with thin aluminous seams. Crossbedding, and the relation of the Ortega and Marquenas quartzites to the intervening Rinconada Formation, show that the two quartzite units are stratigraphically distinct.

Toward the south, sedimentary facies changes in the Marquenas quartzite mirror those in the underlying Rinconada Formation and occur in the same location. West of Pecos Baldy, south of the transitional zone, the Marquenas contains magnetite rather than hematite and has interlayers, 5 cm to 2 m thick, of graphitic graded-bedded schist. Although most of the quartzite is white to gray, some horizons are slightly green and contain disseminated muscovite and chlorite together with trace amounts of chloritoid. A few conglomerate or breccia layers have been observed south of Pecos Baldy.

Vadito Formation

Stratigraphically above the Marquenas quartzite are rocks which I have correlated tentatively with the Vadito Formation of the Picuris Range. Exposed in a syncline centered on Truchas Peak (fig. 3), this unit consists primarily of metavolcanic and metavolcaniclastic rocks interlayered with lesser amounts of metasedimentary material. Metavolcanic rocks form a bimodal igneous suite. Amphibolite and mafic biotite-hornblende gneiss, interpreted as metabasaltic flows, appear as 1-25-m-thick, laterally discontinuous beds showing sharp conformable contacts with metasedimentary lithologies. Textures resembling pillows and infilled vesicles are seen locally. Chemical data indicate that the amphibolite and mafic gneiss have tholeiitic affinities and are transitional between oceanic and continental tholeiites (Grambling, in prep.).

Thick accumulations (up to 100 m) of snow-white quartz-muscovite-feldspar schist are interbedded with the metabasalts. These schist layers commonly are banded, with thin alternating quartz- and feldspar-rich layers. Horizons contain variable amounts of plagioclase (0-30%), and muscovite averages 50 modal %. Beds are conformable and commonly lenticular; contacts are gradational with quartzite but sharp with metabasaltic units. Chemical analyses of these rocks show that they vary between the granite-minimum composition and the SiO2 apex of an or-ab-q diagram (Grambling, in prep.). They probably represent variable amounts of sedimentary reworking of original rhyolitic tuffs or pyroclastic flows.

Intercalated with the volcanic suite are beds of sedimentary origin. Thin units of crossbedded hematitic quartzite, similar in appearance to other quartzite horizons in the stratigraphy, appear throughout the Vadito section. Most are only 4-5 m thick, but a few reach 250 m in thickness. There are some pelitic sedimentary layers which reach 10 m in thickness. Hematitic feldspathic schist, rich in mafic and aluminous minerals, is quite common and probably formed from debris weathered and reworked from nearby basaltic flows. Some sedimentary beds contain trace amounts of Zn-bearing minerals, either zincian staurolite (up to 5.85 wt% Zn0), or a blue isotropic phase tentatively identified as gahnite.

A porphyritic rhyolite stock, surrounded by a halo of brecciated quartzite, intrudes the Ortega quartzite and Rinconada Formation west of Pecos Baldy (fig. 3). The rhyolite, containing euhedral plagioclase and rounded quartz phenocrysts, is pre-metamorphic and appears to be a subvolcanic intrusion. This is the first reported occurrence of igneous rocks intrusive into the Ortega or Rinconada formations (see Gresens and Stensrud, 1974); it may represent a crystallized feeder for the overlying Vadito nnetarhyolites.

Truchas Quartzite

Overlying the metavolcanic and metasedimentary Vadito rocks is yet another massive quartzite. The Truchas quartzite, cropping out along the center of the syncline running east and west from Truchas Peak, is crossbedded and hematitic, and it contains thin aluminous seams; in short, it is compositionally and texturally identical to the Ortega quartzite, the northern facies of the Rinconada and Marquenas quartzites, and to quartzites within the Vadito Formation. This is the youngest unit exposed in the Truchas Range.

DEPOSITIONAL ENVIRONMENTS

Facies changes shown by rocks of the Truchas Range suggest variable environments of deposition for the Truchas Group. At the southern end of the range, the stratigraphic section is dominated by thick turbiditic and reduced (graphitic) metashale. Quartzite beds contain accessory magnetite, rather than hematite, and are thinly interbedded with pelitic material. The exposed units pass through a transitional zone near Quartzite Peak (fig. 4) where pelitic beds thin and become more aluminous as quartzite layers thicken, becoming hematitic and extremely pure. In the northern Truchas Range, quartzite is the predominant rock type.

The southern end of the Truchas Range seems to reflect deposition in a deep-water basin. The quartzite-dominated facies north of Quartzite Peak must have accumulated in a shallow-water regime, as evidenced by the hematitic (oxidized) nature of all metasedimentary horizons and the well-sorted appearance of the quartzites. Modern deposits analogous to the pure quartzite layers are limited to continental-margin beach sands. However, no transgressive sands preserved in the Phanerozoic record are as thick (over 1000 m) as the quartzite of the Truchas Group. A closer analogy to rocks of the northern Truchas Range might be the extensive Phanerozoic sheet sands which cover parts of the African craton: the Mesozoic Nubian sandstone of northern Africa (Harms, 1977; Klitzsch and others, 1979; .Weissbrod, 1978) and the pre-Devonian Table Mountain sandstone of South Africa (duToit, 1954). Both are geographically widespread, attain thicknesses in excess of 1000 m and are composed of pure quartz sand with thin shale or kaolinitic clay interbeds. The depositional environment of each has been interpreted as shallow-water marine to fluvial, and both rest atop older continental rocks.

By analogy, the northern facies of the Truchas Group may have been deposited in a similar environment.

Metavolcanic rocks of the Vadito Formation are underlain and overlain by massive quartzite, and so, do not represent a changing depositional /tectonic environment, but rather exist as flows, tuffs and volcanic debris deposited and reworked atop the stable continental sequence. Their source may have been in the Pecos greenstone belt south of the Truchas Peak area (Robertson and Moench, this guidebook), or possibly, the subvolcanic complexes of the southern Picuris Range (Long, 1976; Montgomery, 1953).

STRUCTURE

The Truchas Range is bordered on the west by a fault which extends far to the north and south, and has had an extensive history of motion. Based on stratigraphic and structural correlations of Precambrian rocks, Montgomery (Miller and others, 1963) inferred that about 37 km of right-lateral offset occurred along the Picuris-Pecos fault in Precambrian time. Sutherland (Miller and others, 1963), from studies of Paleozoic rocks adjoining the fault, suggested that the structure was active during deposition of the Mississippian-Pennsylvanian section and was reactivated, with accompanying vertical offset, in the Laramide orogeny. Where the fault plane is visible today, it dips to the west at 800, with the west side upthrown.

Both Precambrian basement and Mississippian-Pennsylvanian cover have been sliced by a series of fractures subparallel to the Picuris-Pecos fault. Most of these are west-dipping high-angle reverse faults; in the northern part of the range, the faults show a westward progression of offset. Several form the irregular eastern boundary of the metamorphic terrane.

An east-trending pre-Mississippian fault, which truncates Precambrian structures and is expressed by isolated pockets of fault breccia, cuts the metasedimentary rocks south of Pecos Baldy. It may be a westward continuation of an east-trending fault which is exposed in the Pecos River and Rio Valdez valleys to the east (Robertson and Moench, this guidebook).

Map patterns of the metasedimentary rocks express two periods of folding. Most prominent is a set of pre- to syn-metamorphic, east-trending, tight to isoclinal folds. These folds, slightly overturned to the north, plunge gently east and west, and have axial-plane foliation. They are warped by a series of slightly younger, syn- to post-metamorphic open folds which trend northerly and may plunge gently to the south. These later folds are subparallel to the Picuris-Pecos fault and may result in part from right-lateral drag during fault motion (Montgomery, in Miller and others, 1963) or from the same stress field responsible for the faulting.

METAMORPHISM

Metamorphic phenomena important to an understanding of the Precambrian geology of northern New Mexico can be divided into two groups: (1) a series of dehydration reactions which confuses stratigraphic relationships in the Rinconada Formation; and (2) reactions involving the Al2Si05 minerals, which yield information concerning regional heat flow during the Precambrian metamorphic event and are applicable to the postulated reconstruction of terranes on opposite sides of the Picuris-Pecos fault (Montgomery, in Miller and others, 1963).

Dehydration Reactions

Two prograde dehydration reactions, (1) chlorite + muscovite = staurolite + biotite + quartz + H20 (staurolite-in), and (2) chlorite + muscovite + staurolite = andalusite + biotite + H20 (andalusite-in), occur within the Rinconada Formation and Marquenas quartzite south of Quartzite Peak and west of Pecos Baldy (fig. 5). The first reaction cuts across the entire Rinconada-Marquenas section; the second intersects the northern edge of the Rinconada upper pelite in the south limb of the Quartzite Peak syncline. The two isograds lie entirely within graphitic units, over most of their lengths paralleling the boundary between graphitic and hematitic rocks.

Downgrade (southwest) of the staurolite-in isograd, all pelitic units are phyllitic, containing tiny porphyroblasts of garnet, biotite and chlorite. Concomitant with the first appearance of assemblages containing both staurolite and biotite, phyllite coarsens into schist. At the andalusite-in isograd, the schist becomes extremely coarse, spotted with poikiloblastic andalusite masses up to 10 cm in diameter together with randomly oriented, 1-cm tabular books of biotite.

Although these isograds trend subparallel to lithologic contacts, they are not controlled stratigraphically. The Rinconada upper pelite is repeated several times by folding both south and north of the Quartzite Peak syncline (fig. 4b). In no other locality does it contain andalusite + biotite. Instead, the formation of andalusite + biotite-bearing assemblages seems to occur only where the graphitic Rinconada Formation contacts the hematitic facies of the Marquenas quartzite (farther south,

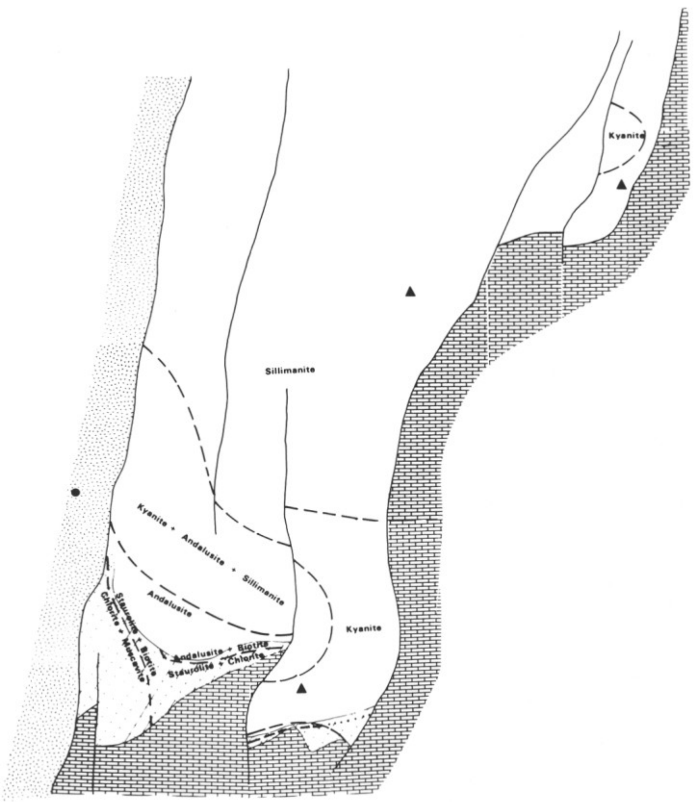

Figure 5. Isograd map of the Truchas Peaks area. The two dehydration isograds (in the southwest corner) are subparallel to the boundary between graphitic rocks and hematitic rocks. Triangles: locations of Chimayosos Peak, Truchas Peak and Pecos Baldy.

the Marquenas is graphite-bearing; farther north, the Rinconada is graphite-free): near the sedimentary facies transition zone (fig. 4). The isograds have formed as a result of a metamorphic process involving simultaneous oxidation of graphite and reduction of hematite (Grambling, in prep.).

In the Picuris Range, a similar andalusite-biotite schist is present along the contact between the graphitic Rinconada Formation and the hematitic Ortega quartzite (Montgomery, 1953). It is likely that this layer, even though present in a different stratigraphic position, had an origin similar to the andalusite-biotite schist of the Truchas Range.

Aluminum Silicates

All three aluminum silicate minerals (kyanite, andalusite and sillimanite) are found in the Truchas Range. North of the Rio Medio, rocks contain sillimanite or sillimanite + kyanite. In the eastern part of the area, along the ridge extending from Pecos Baldy and East Pecos Baldy to the Rio Medio, only kyanite can be found. South and west of Pecos Baldy, andalusite or andalusite + kyanite are present. A zone of triple-point assemblages, 1 km wide and 4 km long, extends from the Picuris-Pecos fault at the Rio Medio eastward to Quartzite Peak (fig. 5). The geographic distribution of polymorphs suggests that the coexistence of andalusite, kyanite and sillimanite represents a stable occurrence of the triple point (Grambling, in prep.).

The interaction of aluminum silicate isograds with faults and topography allows the spatial distribution of the polymorphs to be inferred. This is shown in Figure 6; the kyanite zone overlies both the sillimanite and andalusite zones, the kyanite-sillimanite isograd dips south, the kyanite-andalusite isograd dips north, the andalusite zone is a wedge which pinches out to the north, and the trace of the triple point plunges to the east. By applying experimental data on aluminum silicate stability (Holdaway, 1971) to the distribution of the polymorphs, it is possible to visualize the variations in heat flow which affected the rocks during metamorphism (fig. 7).

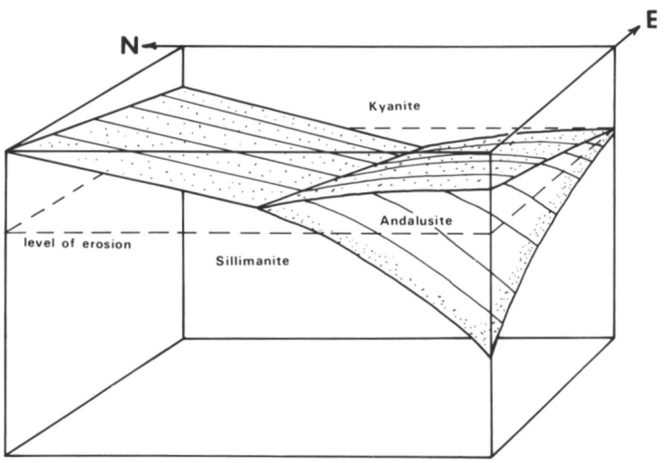

Figure 6. Sketch showing aluminum-silicate isogradic surfaces in the Truchas Range. The kyanite-sillimanite isograd dips south, the kyanite-andalusite isograd dips north, and the triple-point trace plunges to the east. The kyanite zone overlies both the andalusite and sillimanite zones; the andalusite zone is a wedge pinching out to the north. The present level of erosion is shown.

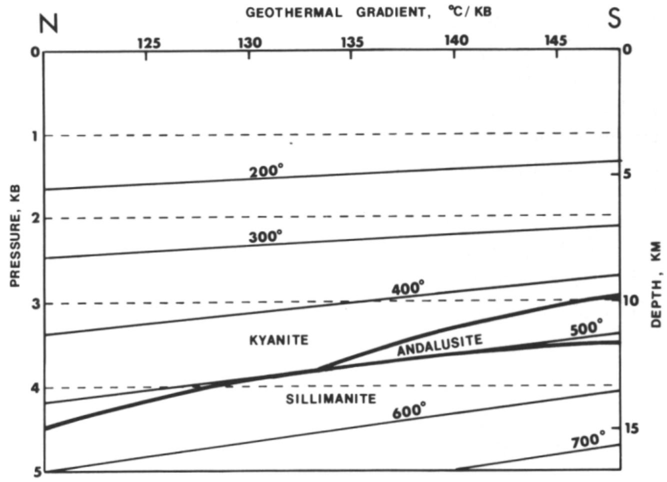

Figure 7. Schematic N-S cross section through the Truchas Peaks area during metamorphism, showing how the aluminum-silicate isograds (solid heavy lines) depend upon the intersection of isotherms (solid light lines) with isobars (dashed lines), which intersection, in turn, depends upon regional heat flow. Aluminum-silicate stability after Holdaway (1971).

The east-west extent of triple-point assemblages indicates that heat flow was uniform along east-west lines during metamorphism, but rocks at a given depth were hotter at the south than the north end of the Truchas Range, indicating that heat flow increased from north to south during the metamorphic event.

REGIONAL RECONSTRUCTION

Montgomery (Miller and others, 1963) noted that the stratigraphy near Pecos Baldy was virtually identical to that of the Hondo syncline in the Picuris Mountains and suggested that the two areas were adjacent prior to offset along the Picuris-Pecos fault. Montgomery's reconstruction places the Picuris Range to the southwest of the Truchas Range, lines up thE contact between the Vadito and Ortega formations in thc southern Picuris Range with the Pecos greenstone belt—Ortegz formation contact south of the Truchas Range, and also align! fold axes across the fault. This reconstruction explains why bedding in the eastern Picuris Mountains swings southwarc into parallelism with the fault, while bedding in the westerr Truchas Range is bent to the north.

Although my interpretations of the geology of the Truchas Peak area are slightly different from those of Montgomery, I have found no evidence against his right-lateral offset theory. In fact, metamorphic zonation in the two areas supports the reconstruction. Triple-point assemblages are found in both the Truchas Range (this study) and the Picuris Mountains (Holdaway, 1978). If the two areas are reassembled in Montgomery's reconstruction (fig. 8), the two triple-point zones line up in an east-west band, which agrees with the pattern expected from a consideration of metamorphic heat flow (figs. 6 and 7).

The Pilar phyllite lies in the core of the Hondo syncline in the Picuris Mountains (Montgomery, 1953), while the overlying Marquenas quartzite occupies the center of the eastern extension of this fold (fig. 4a) in the southwest corner of the Truchas Range; the Picuris triple-point zone is wider than that of the Truchas Range. Both reflect a slightly deeper level of erosion in the Picuris Range.

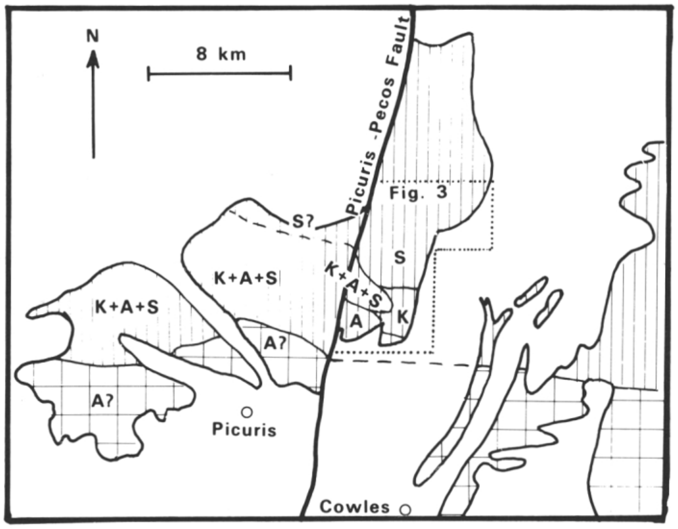

Figure 8. Reconstructed Truchas-Picuris ranges, showing how the aluminum-silicate triple-point zones as well as the Vadito (Pecos greenstone belt)—Ortega formation contact line up across the Picuris-Pecos fault. Isograds in the Picuris Range estimated from Montgomery (1953) and Holdaway (1978). Vadito: crosshatched. Ortega: ruled. K: kyanite. A: andalusite. S: sillimanite.

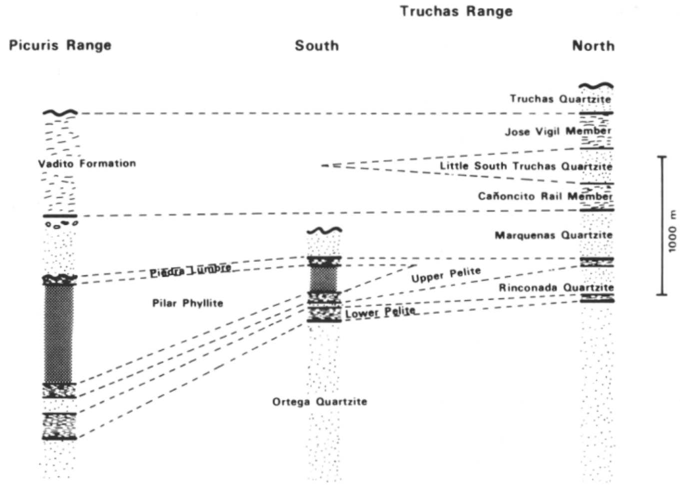

Figure 9. A series of sequential stratigraphic sections (northeast to southwest) through the reconstructed terrane. Picuris section compiled from Montgomery (1953) and Nielsen (1972).

Stratigraphic Trends

By considering rocks of the Truchas Range together with those of the Picuris Mountains and of the Pecos greenstone belt, south of Pecos Baldy (Robertson and Moench, this guidebook), a picture of regional stratigraphic trends can be developed and applied to help decipher the tectonic setting of the north-central New Mexico Precambrian basement. From north to south in the Truchas Range, exposures show a decreasing abundance of quartzite and an increase in the percentage of fine clastic sediments (metashales). Rocks vary from hematitic (oxidized) in the north to graphitic (reduced) in the south, preserving evidence of deeper water, during deposition, toward the south. This trend seems to continue into the southern Picuris Range (fig. 9); pelitic horizons thicken and the Marquenas quartzite becomes conglomeratic and micaceous (Long 1976; Montgomery, 1953). Perhaps reflecting topographic instabilities toward the south (doming prior to rifting?), the Rin. conada-Marquenas contact, which is conformable in the Truchas Range, is unconformable in the southern Picuri Mountains (Long, 1976; Montgomery, 1953).

Additionally, the Vadito Formation changes from north to south. Where exposed in the northern Truchas Range, the Vadito Formation consists of flows of metavolcanic material interspersed with oxidized metasedimentary rocks and cross-bedded quartzite, with the volcanic material apparently extruded onto a stable platform. The Vadito-Marquenas contad is sharp and conformable. In contrast, in the southern Picuri5 Range, the same contact is blurred by the partly intrusive nature of the Vadito (Montgomery, 1953). Massive sulfide deposits are found around felsic volcanic centers in the Peco. greenstone belt (Robertson and Moench, this guidebook) whether the trace amounts of zinc occurring in the Vaditc Formation of the Truchas Range represent part of a base-metal halo surrounding these deposits is not known.

Tectonic Interpretations

Precambrian rocks of the northern Truchas Range were deposited in a tectonically stable environment, probably a shallow-water to subaerial continental platform. In the southern Truchas Range, near Pecos Baldy, the environment of deposition was less stable. Quartzite is less abundant, metashales are thicker and apparently were deposited in a subsiding marine basin. Farther to the south in the Pecos greenstone belt, Robertson and Moench (this guidebook) have speculated that metavolcanic and metasedimentary rocks accumulated in a marine fault-bounded basin either within or adjacent to a rifted continent. Continental rocks of the Truchas Range are interbedded with flows of metabasalt and metarhyolite which probably originated in the greenstone belt and lapped onto the continental margin, implying that the continental environment of the Truchas Range persisted during the postulated development of the greenstone belt. Metarhyolites also have been identified in the Ortega quartzite of the Picuris Range (Gresens and Stensrud, 1974), although these authors seemingly misinterpreted the significance of the rocks (Long, 1976, p. 53); a reasonable reinterpretation is that these metavolcanic rocks represent earlier silicic incursions onto the continental margin. If so, the continental margin and greenstone belt environments may have existed, side by side, for a considerable period of time. On the other hand, evidence of incipient rifting in the deep-water pelitic terrane along the south edge of the continental platform may be preserved as the unconformable Marquenas quartzite-Rinconada Formation contact exposed in the southern Picuris Mountains.

The question of whether the greenstone belt occurred within or adjacent to a continent may depend on the nature of the Ortega quartzite—greenstone belt contact. This contact is exposed in the southeastern Picuris Range and possibly along the tributaries of the Pecos River, but contact relations are not known well.

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