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COAL MINING IN THE WESTERN SAN JUAN BASIN, SAN JUAN COUNTY, NEW MEXICO

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Abstract—Coal mining in New Mexico essentially began in the mid 1800s driven by the expanding network of railroads into the West. An early peak in production occurred around the end of World War I and then began a long decline until the late 1950s. After this long stagnant period for the coal industry, a new market was defined by changing demographics and large-scale mining accelerated in the early 1960's to meet the energy demands of the rapidly growing population of the Southwestern US.

More recent development of coal resources has focused on the creation of thermal electric energy. In San Juan County, New Mexico, the economic coal seams of the Fruitland Fm. exposed along the margins of the San Juan Basin, offer easy access to significant resources amenable to surface- mining methods. In a notable exception, an underground longwall operation has successfully extended coal extraction in a location where increasing overburden created unfavorable economics for further surface operations.

With the clustering of coal-fired power plants adjacent to the various coal mines, new controversies have arisen in recent years focused on regional air quality, economic development of natural resources, global warming, and impacts to the indigenous Native community. Improved mining and innovative reclamation methods, as well as the infusion of hundreds of millions of dollars of environmental technology into local power plants, suggest that coal mining is still a viable industry in New Mexico.

INTRODUCTION

Coal mining and electricity generation are a critical segment of the New Mexico economy as the third-most important source of mineral and energy revenues after oil and gas production in the State. As of 2010, an estimated 50 percent of the energy needs of New Mexico were supplied by coal power; over 75 percent of all electricity generated in the state was from coal-fired plants. The majority of the coal resources in New Mexico are found in the San Juan Basin which also contains large quantities of natural gas (Peach and Starbucks, 2009, p. 12; Fassett, 2010, this guidebook). Active coal mining operations are located in two regions.

In the southern part of the San Juan Basin, Peabody Coal operates two surface coal mines, the Lee Ranch Mine, about 55 km northwest of Grants, NM and the El Segundo Mine, adjacent to the Lee Ranch operation in the Upper Cretaceous Menefee Formation. Mining at Lee Ranch started in 1984. Production in 2008 was 3.4 million tons. The new Peabody El Segundo Mine, opened in 2008, is slated to ramp up production to about 6 million tons when fully operational. The McKinley Mine, owned by Chevron Mining, is located near Gallup, NM and was the first surface mine in the state (Crevasse Canyon Formation). The mine was closed in 2009 after 47 years of production. Final reclamation is scheduled for 2010.

FOCUS AREA

Coal mining operations, located on the west edge of the San Juan Basin (San Juan County, New Mexico), are the focus of this paper. BHP Billiton New Mexico Coal (NMC) owns and operates the mines (the BHP Navajo Coal Company (BNCC) and the San Juan Coal Company (SJCC)) which produce coal from the Upper Cretaceous Fruitland Formation by both surface and underground mining methods (Fig. 1). Both mine operations are located about 15 to 25 km west of Farmington, New Mexico. BNCC is located exclusively on the Navajo Reservation while SJM leases include a combination of private, State and Federal lands. The mine leases stretch nearly 80 kilometers along the Fruitland Formation crop line.

This area of the San Juan Basin is a part of the Colorado Plateau with an elevation above 5,000 feet and is characterized by semiarid to arid climate. The San Juan River cuts through the study area and pierces the prominent Hogback Ridge which defines the basin on the northwest and north. The central part of the basin is a westward-sloping dissected plateau.

The two NMC operations produce a combined output of more than 15 million tons of coal per year to supply two near-by coal-fired power plants. In turn, the two power plants supply electricity to nearly one million families and businesses in Arizona, New Mexico, and other states in the southwest (New Mexico Coal brochure – BHP Billiton, 2007). Figure 2 is an oblique view of SJCC leases with underground mine works transposed and expressions of the surface operations at BNCC Areas 2 and 3. Both the APS and PNM power plants are visible.

GEOLOGIC SETTING

The Upper Cretaceous strata exposed on the west margin of the San Juan Basin include the coal-bearing Fruitland Formation and the underlying shoreface Pictured Cliffs Sandstone. The Pictured Cliffs Sandstone and Fruitland Formation were deposited during the final episode of regression of the Western Interior Seaway from the basin in the Late Campanian Stage (Erpenbeck, 1979). The Pictured Cliffs Sandstone shoreline was oriented roughly northwest-southeast and was fed at intervals by distributary channels flowing from the southwest. The Pictured Cliffs Sandstone is time transgressive (Fassett, 2000, Q12) with a recognizable stair-step pattern apparent in the exposures in the study area. The

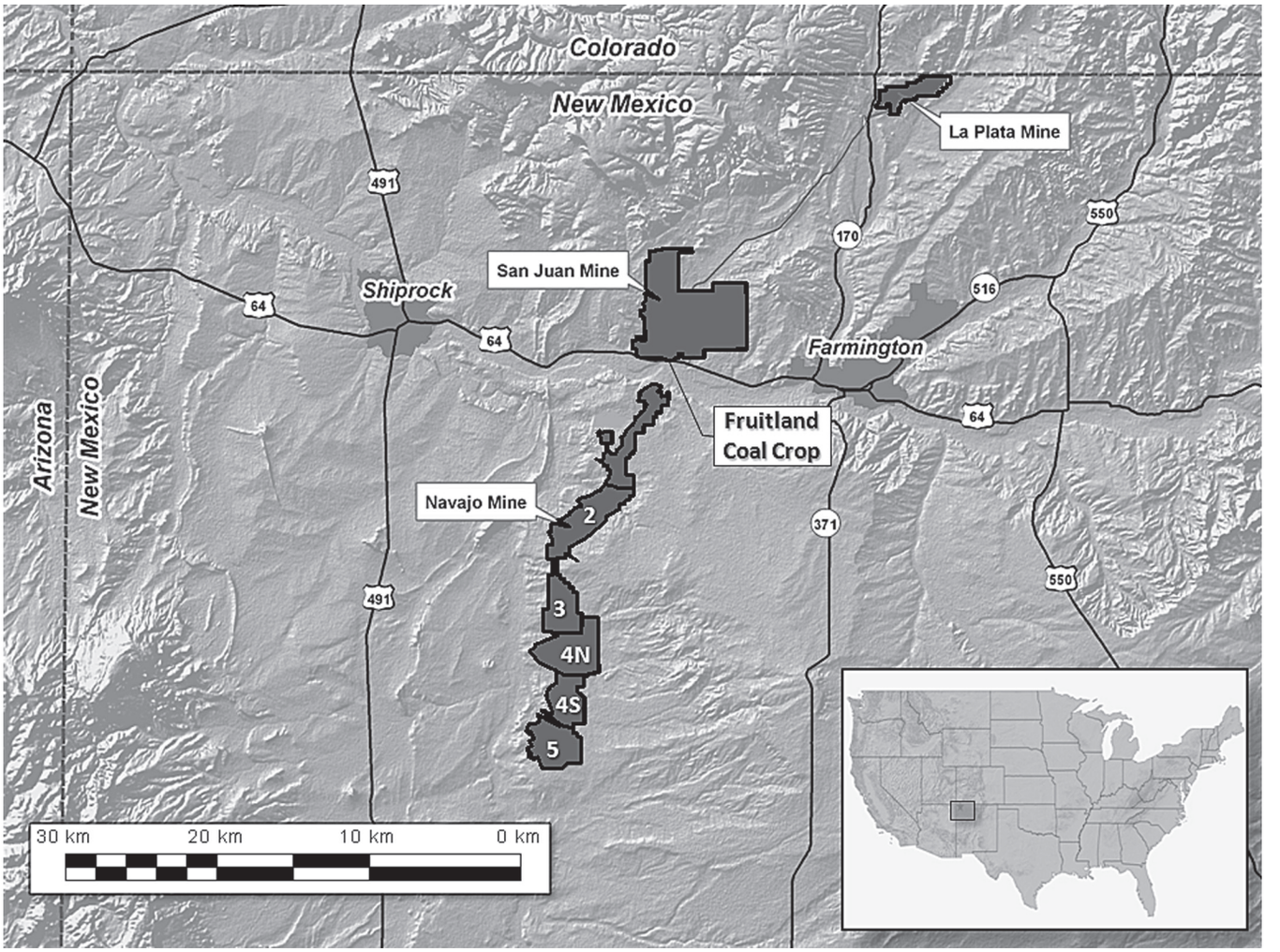

FIGURE 1. Index map of the western San Juan Basin study area in northwestern New Mexico. Highlighted areas identify BHP Billiton New Mexico Coal leases accessing coal seams in the basal Fruitland Formation.

top of the Pictured Cliffs is usually massive in character, grading downward into thinner bedded sandstones and siltstones.

The Fruitland Formation around the study area is approximately 75 Ma old (Fassett, 2000, Q12, Q31) and contains multiple coal beds in the lower 60 meters of the formation ranging from less than a 0.3 m. thick to consolidated benches of over 10 m. (1 to 30 feet) thick. Coal seams are commonly characterized by prominent bands formed by volcanic ash falls (tonsteins) which are traceable across many miles in underground workings or in surface-pit exposures.

Correlation of the coal seams from mine to mine, in the study area, is based primarily on visual clues and stratigraphic position (Fig. 3). Principally, a distinctive ash fall in the lower portion of the No. 8 Seam acts a key marker across much of the area. Correlation of the seams with the La Plata Mine (Fig. 1) is somewhat tenuous as identifiable ash bands are not present. In this case, the time-stratigraphic positions of the familiar bands may exist below the seam.

The coal sections making up the cross section in Figure 3 are shown in apparent association with several step-like episodes of

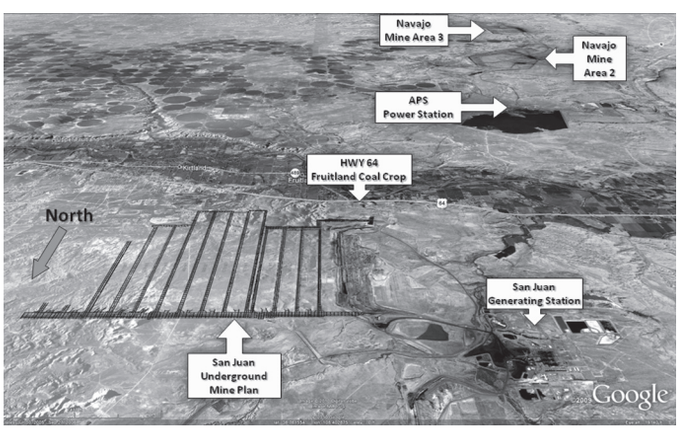

FIGURE 2. Oblique areal view of portions of the San Juan Mine and Navajo Mine (Google Map 2009 image). View looks to the south. The San Juan Mine complex, in the foreground, shows final surface pits and a transposed layout of the underground development. South of the San Juan River are seen parts of the existing surface operations in Navajo areas No. 2 and 3. Exposed Fruitland No. 8 Coal is visible from Highway 64 on the north side of the road as shown.

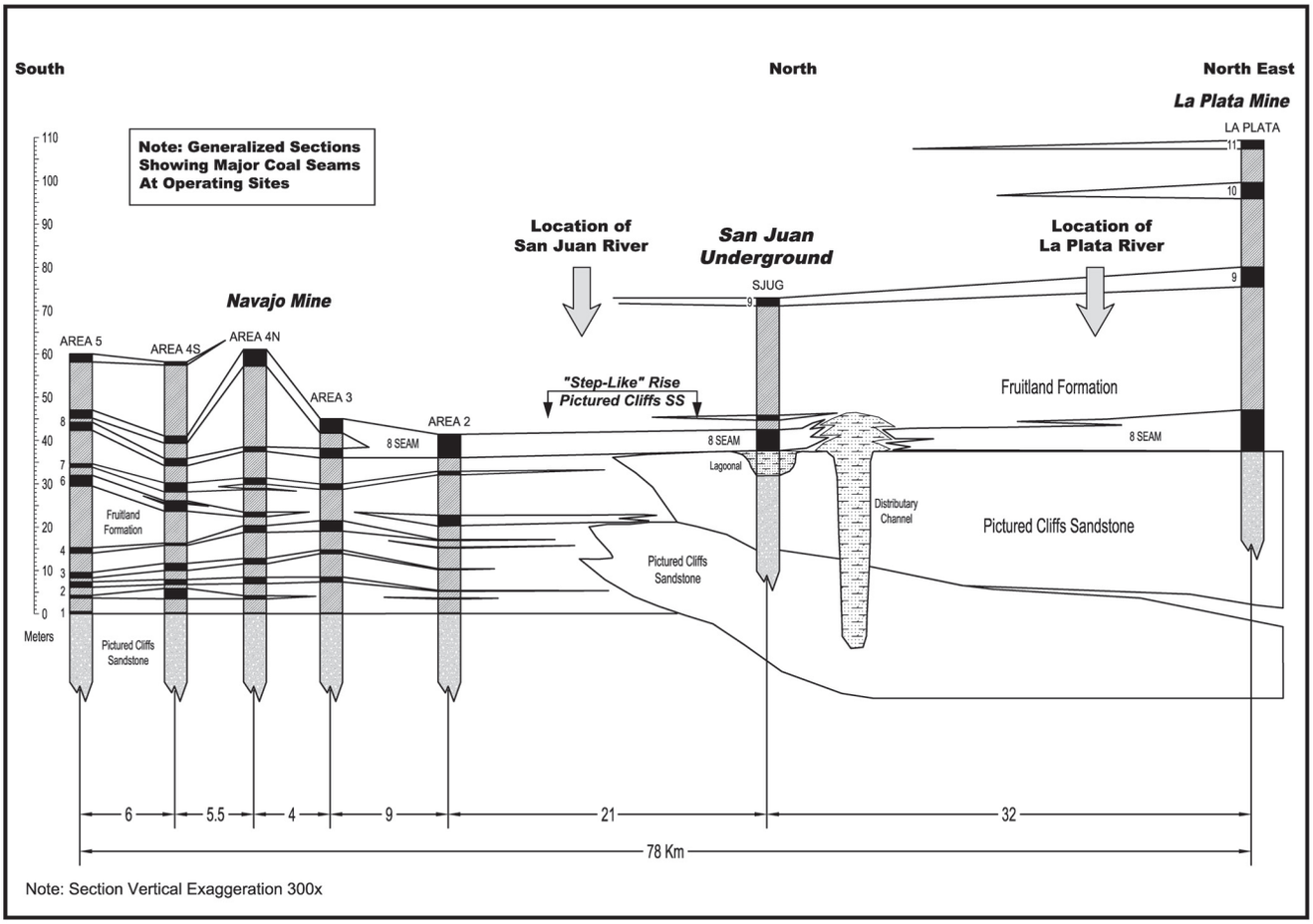

FIGURE 3. Generalized stratigraphic columns illustrating the major coal seam development of the Fruitland Formation across the study area. Suspected position of the underlying Pictured Cliffs Sandstone shoreline "step-like" rise appears to have been eroded by the San Juan River. A north-east trending distributary system is found on the north side of the San Juan Mine. Vertical exaggeration is about 300x.

the regressive Pictured Cliffs Sandstone. The first Pictured Cliffs step-like point in the study area exists between the BNCC and the SJCC operations where the rate of regression of the shoreface sandstone was slowed or stalled. A second step point may exist between the SJCC and the La Plata operations although data are scant in this area. A third (not shown on Figure 3) step-like stratigraphic rise in the regressive Pictured Cliffs Sandstone is located about 13 km north of the La Plata Mine.

Coal seams are identified, from base to top, in ascending numerical order (Seams No. 1 through 11). Coal rank of the Fruitland coals generally falls in the sub-bituminous range due to the high ash content and the resultant low heating value. The Fruitland coal seams and, to a lesser degree, the enclosing carbonaceous mudstones and underlying Pictured Cliffs Sandstone in the western San Juan Basin are significant natural gas producers, even in areas with less than 300 m of overburden.

Strata enclosing the coal seams include lenticular sandstones, siltstones, carbonaceous mudstones, and clay-rich mudstones (Fig. 4). Figure 4 shows some of the complex depositional patterns and stratigraphic detail present on the lower coastal plain environments of the lower Fruitland Formation. Whereas the base of the Fruitland is usually in sharp contact with the Pictured Cliffs Sandstone, a thick wedge of mudstones and lenticular sandstones (> 7 m) underlie the basal coal at SJCC and may represent a back-barrier lagoon deposit on the east side of the San Juan mining leases. A large distributary/fluvial channel, about 1.5 km wide and trending to the northeast, has been identified on the north flank of the San Juan Mine which was contemporaneous with the seam development (Figs. 2, 3). Overbank deposits, splays, and long-term drainage patterns can be traced to this channel system. Abandonment of the main channel resulted in the final burial of the No. 8 Seam in the San Juan area.

In the Navajo area, the extensive seam development appears to have been more controlled by a still-stand of the Picture Cliffs shoreline, for a protracted period of time, before the shore-line began regressing again. The 9 Seam, north of the La Plata area, appears to laterally extend onto another step-like bench of the Pictured Cliffs Sandstone.

Although existing in a structural basin, there are no known regional faults disturbing the Fruitland Formation in the BNCC and SJCC areas. Discontinuities encountered are growth faulting (normal) developed while sediments were being compacted

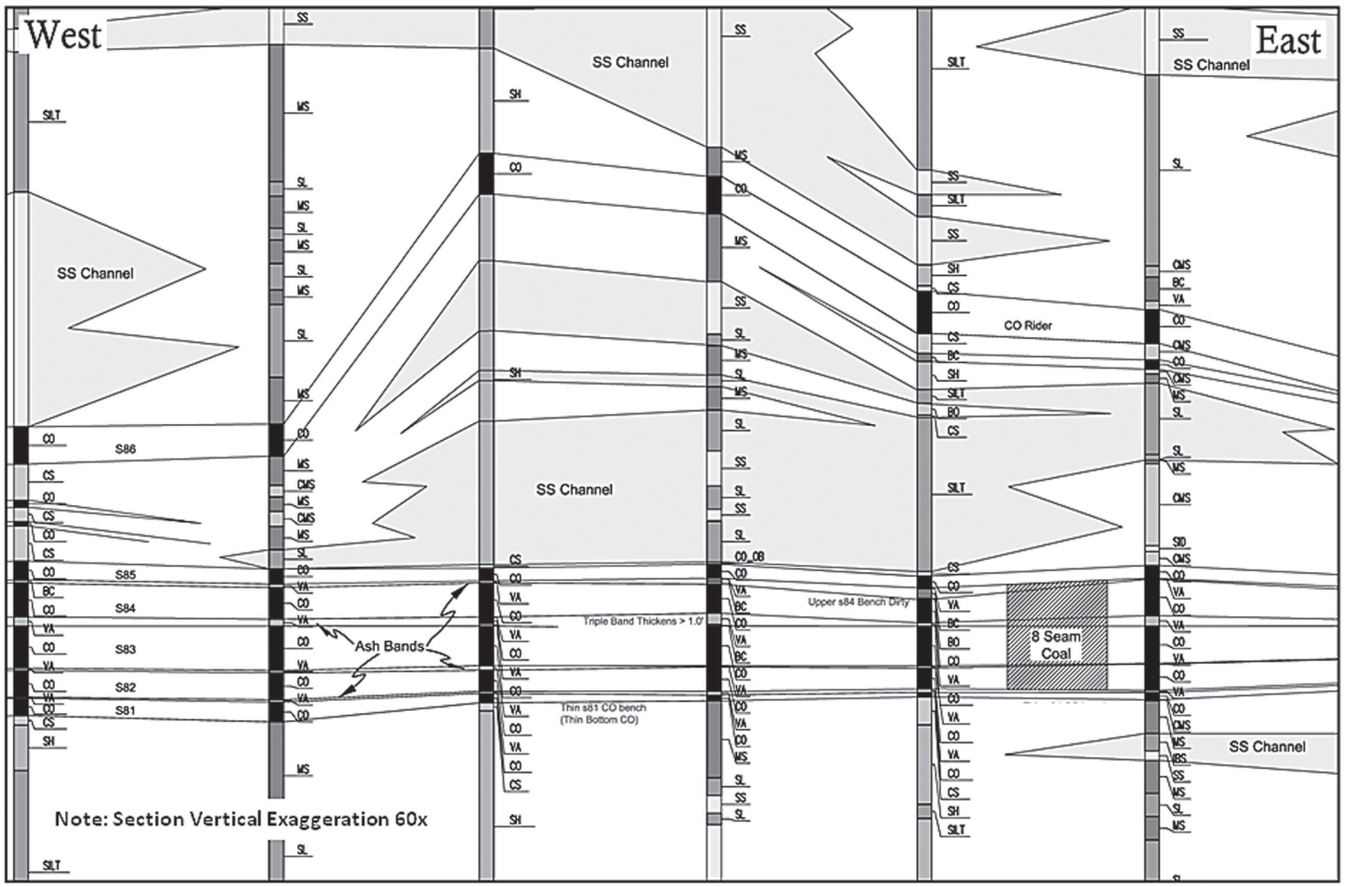

FIGURE 4. Cross section detail in the San Juan Mine leases showing complex development of fluvial channels above the No. 8 Seam and the apparent compactional effects to subsequent rider coal seam development. At this locality, intervening sub-seam lagoonal deposits, ten to twenty feet thick, separate the Pictured Cliffs Sandstone from the base of the coal. Vertical exaggeration is 60x.

(differential compaction). Faults encountered at the underground San Juan Mine are relatively common, are small scale (0.3 cm to 1 m), normal, and of limited areal extent. Numerous faults have been mapped in underground entries; principally, in the seam being mined but also in areas where the roof and floor have been exposed. Exposures in the surface pit highwalls at both the BNCC and SJCC operations exhibit common growth fault development (Fig. 5). Offsets can range from less than a meter to over 10 meters (1 to 30 feet). Some significant faulting was encountered while surface mining at the La Plata operation. This structure appears to be related to flexuring in the Hogback to the north. Seismic profiles suggest a large, irregularly displaced thrust fault along the northeast trending Hogback ridge.

Seam dips at BNCC range from two to five degrees. Seam dip at the SJCC underground operations ranges from one to three degrees and flattens as mining progresses away from the crop. Overburden ranges from 120 m to more than 300 m (400 to over 1000 feet). Dip of strata at the La Plata operations ranged from 30 to 50 degrees off horizontal.

OPERATIONS HISTORY

New Mexico Coal was originally an asset of Utah International. In 1977, Utah International was acquired by General Electric, and subsequently, by BHP in 1984. New Mexico Coal became a part of BHP Billiton with the merger of BHP and Billiton in 2001.

Production activities at New Mexico Coal are centered about the concept and culture of "Zero Harm" as a commitment to employees, families, and surrounding communities. BHP Billiton New Mexico Coal endeavors to manage risks related to the mining operations so that employees, property, environment and communities are not harmed. Mining methods at the surface and underground operations are quite different as shown in Figures 6 and 7. The main material movers at the surface operations are large draglines with supporting fleets of drills, dozers, and loaders. Underground operations revolve about a longwall system with supporting continuous miners, bolters, and scoops and coal haulers. Mining on the SJCC leases is somewhat complicated by overlapping ownership of coal and gas leases.

BHP NAVAJO COAL COMPANY

Large-scale surface mining started on the Navajo Reservation in 1963 and all production from the BNCC mines has been directed to the existing units (three in the 1960s and five from the 1970s to the present) of the Four Corners Power Plant. The power plant, majority owned by Arizona Public Service (APS), is capable of producing around 2200 MW. APS plant coal con-

FIGURE 5. Typical growth-fault development in the Lower Fruitland Formation. Volcanic ash fall partings (tonsteins) are visible in the exposed coal seam. Small scale compactional faulting is common in the coal seams.

sumption is approximately 24,000 standard tons/day.

The Navajo Mine is presently comprised of six resource areas (from north to south – Area 2, Area 3, Area 4 North, Area 4 South, and Area 5) as shown in Figure 1. Current production is from active pits in Areas 2 and Area 3. Initial stripping in Area 4 North is underway for the first box cut. Run-of-mine product from the various areas is delivered to a series of stockpiles, blended and loaded into train cars, and hauled by rail to the APS plant site. Previous mining in the BNCC lease areas was limited to a small underground operation at the north edge of Area 1 and a small surface pit in the northern part of Area 2. These areas were later mined through by BNCC as mining expanded in the northern resource blocks. Area 1 has been mined out and reclaimed.

Surface operations at the Navajo Mine are supported by three draglines (Fig. 6), blast-hole drills, twelve D10 and D11 dozers, ten front-end loaders, ten end dump trucks, five 240-ton bottom-dump coal haul trucks, and an on-mine rail line from the various stockpiles to the power plant. About 2500 drill holes are contained in the BNCC data base. Stripping cutoff is approximately 5:1 (total yards, including re-handle) to one ton of coal).

SAN JUAN COAL COMPANY

Surface mining at the San Juan Mine began in 1973 and developed into a series of box cuts which followed the Fruitland coal outcrop for about 13 km. Again, all production of the mining operations was directed to supply the four-unit power plant operated by Public Service of New Mexico (PNM). The PNM plant currently produces about 1850 MW. Daily plant consumption averages about 18,000 standard tons/day.

Surface production from SJCC came from two draglines and a supporting fleet of dozers, loaders, drills, and end-dump trucks. With the closure of the surface operations, the equipment has been re-assigned to support the underground activities. San Juan Coal Company was expanded with the addition of the La Plata Mine in 1986. The La Plata Mine was located approximately 30 km to the northeast of the main San Juan operations (Fig. 1) and delivered production to the plant area by truck on a dedicated haul road. La Plata surface reserves were exhausted and mining ceased in 2002. Mining at the La Plata Mine segment of the SJCC operations was accomplished with a single shovel, two blast drills, two loaders, five end-dump trucks, and six long-haul 240 ton bottom-dump trucks. With the approach of the depletion of the final economic surface mineable coals, a series of studies were undertaken to identify viable new resources to supply the San Juan Mine customer.

Resource options studied included adjacent surface mineable properties, delivering coal from the Navajo Mine area, and the possibility of producing coal from a large-scale underground operation. Because there was no history of applicable under-

FIGURE 6. Marion 8750 Dragline working in Area 2 at Navajo Mine. The job of this workhorse is to remove the rock overlying the coal seams so that the coal can be recovered. The machine "walks" on a series of "tubs" to move from one site to the next.

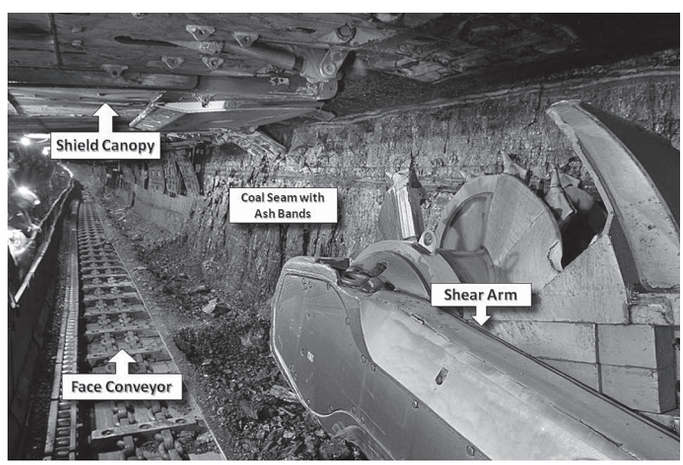

Figure 7. Underground view of the San Juan Mine longwall face. The mining is accomplished by an articulated set of components which, in part, support the roof (shields), cut the coal (shearer), and remove the mined coal (face conveyor). The equipment mines the coal from a large block (Panel) 1000 feet wide, miles long and over ten feet thick.

ground mining in the San Juan area, an underground "Pilot Mine" was started in 1998 to see if the mining approach could be successful. The pilot-mine project was abandoned in 1999 while surface options were being pursued. In 2000, New Mexico Coal approved the underground option and the Pilot Mine was re-activated and new portals were started later that year in the final pit highwall. Longwall production first started in October, 2002.

Presently, production from the San Juan UG Mine comes from a single Longwall Face (Fig. 7) comprised of a large capacity Armored Face Conveyor (AFC), 176 two-leg hydraulic shields, and a coal shear utilizing two 2 meter drums and two Miner Sections using two continuous miners, four battery powered coal haulers, four roof bolters, and three low-profile loaders. Production is delivered from the underground by belt to a surface stacker tube and trucked the final 2.5 km to the power plant.

On the surface, three front-end loaders and six 160 ton end-dump trucks move the coal product to the customer or various stock piles. Coal is pushed and piled by a fleet of five D11 and D10 dozers. Four ash trucks move power plant ash (CCB) from the plant back for burial in surface pits. The longwall faces are 305 m. (1000 feet) wide and average over 3 km (10,000 feet) long. A large stockpile inventory is maintained against the possibility of underground mine disruptions. Over 850 drill holes are accessed in the SJCC data base.

ECONOMIC IMPACT

Since the startup of mining in 1963, the various operations which comprise BHP Billiton - New Mexico Coal, over 500 million short tons of coal have been produced (roughly 320 million from Najavo Mine, 150 million tons from San Juan Mines, and 40 million tons from La Plata Mine) as shown by Beaumont, 1998, and others. These steady, long-term well-paying job opportunities have had a major influence on the economies of the region, State, and local communities. For example in 2007, approximately $117 million dollars in taxes and royalties were paid to federal, state, tribal, and county governments. In addition, about $80 million dollars entered the local economy in the form of payroll, and nearly $190 million dollars into the regional economies in the form of purchases of equipment, services, and materials (BHP New Mexico Brochure, 2007).

Presently, New Mexico Coal employs over 1,000 people (SJCC – about 575, BNCC – 435, FO – 50). About 65 percent of the employees are Native American, 12 percent are female. Two Collective Bargaining Agreements with the International Union Operating Engineers are administered by BHP Billiton NMC covering about 70 percent of the workforce (New Mexico Coal brochure – BHP Billiton, 2007).

Employee and company contributions back to the community totaled more than $1.2 million in 2007 for institutions such as Childhaven and United Way. Additionally, numerous scholarships totaling over $100,000, were awarded. A Native American Professional Development program is also in place to recuit, employ, develop, and promote native professionals (New Mexico Coal brochure – BHP Billiton, 2007).

MINING FUTURE

Increased scrutiny on the mining industry is creating a certain degree of uncertainity in the business. The climate-change debate, changing air quality standards, changes in federal standards (and administrations), and new focus on "clean" energy sources has threatened on-going business and clouded future projections.

Opposition to coal mining development in New Mexico has recently focused on disposal of "Coal Combustion Byproducts" (ash from coal combustion) and the proposed Desert Rock coal plant project. The Sithe Global Power subsidiary, named the Desert Rock Energy Company, has proposed to construct a 1500 MW coal plant on the Navajo Reservation. The plan has encountered significant opposition for years from environmental groups, local citizens, and legislators. The Air Quality Permit was approved in 2006 and the draft environmental impact statement (EIS) was subsequently issued.

In September, 2009, the Air Quality Permit was remanded by the EPA for "further study"; indefinitely delaying the project. Following in December, 2009, the Bureau of Indian Affairs decided to cease work on the Desert Rock Environmental Impact Statement and other permitting as a result of environmental policy changes and challenges from environmental groups.

Both the BNCC and SJM operations have sufficient resource bases to allow for continued surface and underground mining for many years to come.

ENVIRONMENT AND RECLAMATION

Environmental management at the New Mexico Coal operations is driven by a commitment to achieve or exceed leading industry practices. To ensure operations meet industry leading standards, New Mexico Coal conducts environmental monitoring for all mining and reclamation sites. New Mexico Coal strictly adheres to Tribal, State, and Federal regulations required including the Surface Mining Control and Reclamation Act (SMCRA) permit issued by the State of New Mexico Mining and Minerals Division (MMD) at the San Juan Mine and the Office of Surface Mining at Navajo Mine (OSM).

BHP Billiton New Mexico Coal obtained ISO 14001 certification for its Environmental Management System (EMS) in 2004. New Mexico Coal San Juan and Navajo Mines were the first U.S.-based coal operations to achieve this international certification. ISO 14001 certification requires continuous improvements requiring NMC to not only maintain high standards but continually improve them. The EMS is in place to identify environmental risks associated with the NMC operations, develop controls to eliminate or reduce risks to acceptable levels, and to accurately monitor mining effects on the surrounding environment. Regulatory approved surface and ground water monitoring programs have been in place for over 30 years.

At the San Juan Mine, coal combustion byproducts (coal ash or CCB's) are back hauled from the PNM plant for burial in surface pits prior to final reclamation. Monitoring data is submitted

to MMD on a quarterly basis and is available to the public. San Juan Mine is inspected for compliance by regulatory authorities on a monthly basis.

BHP Billiton NMC has developed and implements a process of geomorphic reclamation and is applying this innovative, award-winning reclamation technology to both mining operations with positive and impressive results. The approach utilizes re-grading techniques and channel designs based on fluvial geomorphological principles which are recognized as leading technology improvement by industrial, scientific, and regulatory groups (New Mexico Coal brochure – BHP Billiton, 2007).

To ensure NMC creates a suitable environment for generations to come, SMCRA requires a ten-year bond period. When reclamation and final seeding of the mining areas are complete, a ten year monitoring period starts. In part, NMC monitors to ensure vegetation and wildlife return. Native vegetation is planted to increase the likelihood of re-vegetation success. Part of NMC's continuous reclamation improvements is by the use of different seed mixes based on slope and aspect variances.

CONCLUSION

For the people who work for BHP Billiton New Mexico Coal and the 125,000 residents of San Juan County and the adjacent Navajo Reservation, the coal mining industry has been an important economic mainstay for generations. Abundant and accessible coal resources, a stable, talented workforce, nearby markets, and evolving technology are key parameters which assure that the safe and efficient development of energy resources for the future will continue to be located in San Juan County, New Mexico.

REFERENCES

BHP Billiton - New Mexico Coal Brochure, 2007, BHP Billiton.

Beaumont, E.C., 1998, Distribution of Near-Surface Coal Deposits in San Juan Basin, New Mexico: New Mexico Bureau of Mines and Mineral Resources Resource Map 19, 2 sheets, scale 1:250,000.

Erpenbeck, Michael F., 1979, Stratigraphic Relationships and Depositional Environments of the Upper Cretaceous Pictured Cliffs Sandstone and Fruitland Formation, Southwestern San Juan Basin, New Mexico, Master's Thisis, Texas Tech University.

Fassett, James E., 2010, Oil and gas resources of the San Juan Basin, New Mexico and Colorado: New Mexico Geological Society, 61st Field Conference Guidebook, p. **xx-xx.**

Fassett, J.E., 2000, Geology and coal resources of the Upper Cretaceous Fruitland Formation, San Juan Basin, New Mexico and Colorado, Chapter Q, in Kirschbaum, M.A., Roberts, L.N.R., and Biewick, L.R.H., eds., Geologic Assessment of Coal in the Colorado Plateau: Arizona, Colorado, New Mexico, and Utah, compiled by Colorado Plateau Coal Assessment Group: U.S. Geological Survey Professional Paper 1625-B, p. Q1-Q131. [CD-ROM] http://pubs.usgs.gov/pp/p1625b/Reports/Chapters/Chapter_Q.pdf

Peach, J,. and Starbuck, C.M., 2009, The Economic Impact of Coal Mining in New Mexico, Final Technical Report, DOE AWARD Number: DE-NT0004397