A. TOBLIN STAFF EXHIBIT 11

NIRS/PC EC-1

SECTION VI

GEOLOGY REPORT

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The faults in the red beds on the upper wall show a pattern of anastamozing slip surfaces, with many of the south- and north-dipping slip planes appearing to pair up and join into a primary slip plane with smaller dendritic slip surfaces splaying off the primary plane. The fault planes on the upper wall dip at about 30° to 40° to the northeast and southwest. Strikes of the fault planes on the upper wall show a maximum at about 284° (north 76° west) (Figure 6.4-18). Slickensides on the fault planes show dip-slip movement, with slickenside azimuths between about 340° and 30° (north 20° west and north 30° east) (Figure 6.4-19), consistent with the 15° apparent compressional stress azimuth of the faults on the lower wall.

During late Jurassic or early Cretaceous time, it appears that the upper part of the red beds was subjected to geochemically reducing conditions that altered the red bed clays from red to gray. The thickness of the altered layer is very uniform along the upper wall, which suggests that the alteration occurred while the top of the red beds were at some relatively uniform elevation, prior to faulting or folding. The reducing conditions and vertical downward advance of the alteration front suggest that the area may have been a submerged bog or shoreline with relatively stagnant, marshy conditions.

The alteration occurs to a very uniform depth marked by a sharp vertically delimited alteration front of about ¼ to ½ inch where the color of the red beds changes from gray to red. The sharp alteration front is most likely a diffusion front within the relatively impermeable clays. The uniform depth of penetration suggests matrix-dominated transport of a diffusion front, since the alteration front does not extend significantly further downward adjacent to the joints or fractures. The joints, though preferred fluid paths and perhaps marginally more transmissive than the unfractured matrix, apparently did not allow any significant additional downward penetration of alteration fluids. The joints were essentially non-transmissive to alteration fluids, likely due to the presence of swelling montmorillonite clays (Glass et al., 1973) and joint closure.

Liesegang banding between joints is very well developed within the altered layer. The liesegang banding parallels and mimics the joint surfaces in three dimensions. Alteration clearly occurred post-jointing, most likely as successive diffusion fronts moved inward from the joints from all directions under saturated conditions. The altered layer may have developed under successive, perhaps seasonal, wetting and drying conditions, with liesegang banding developing between joints as the joints swelled closed on passage of the wetting fronts.

At the top of the gray altered layer was a readily apparent parting that was present over approximately 80 to 90% of the exposed wall. The parting appears to be an erosional/depositional surface of either late Jurassic or early Cretaceous age based on the presence of some Cretaceous-aged gravels mixed into the upper portion of the zone above the parting. Above the parting are both reworked altered red beds (reworked and redeposited clays of the altered layer) as well as a second zone of alteration in the southern part of the wall where the reworked clays of the gray altered layer have apparently been further altered to a mixture of silt- to sand-sized crystalline carbonates and sulfates.

Above the reworked or reworked and altered clays are the Cretaceous-aged Antlers Formation sands and gravels. The lower part of the Antlers Formation contains numerous clasts and angular blocks of altered upper red beds or reworked altered red beds. The Antlers Formation exhibits a depositional pattern characteristic of braided streams, with a sequence of younger channels cross-cutting older channels and smaller channels a few tens of feet in width embedded within larger channel deposits. The Antlers Formation sands and gravels range from well-sorted fine to medium grained sands to poorly sorted sands and gravels with occasional cobble-sized particles. The lower few feet of the Antlers Formation is poorly to partially cemented sands and gravels apparently unaffected by the calichification process which is readily apparent in the upper parts of the section. Some of the finer sands higher in the section exposed on the upper wall appear well cemented, although the cementing may be due in part to the development of the caprock caliche.

The relationship between faulting in the Triassic red beds and the overlying Cretaceous Antlers Formation was carefully evaluated to determine if any displacement of the younger Cretaceous deposits had occurred. The Triassic red beds are separated from the overlying Cretaceous Antlers Formation sands and gravels by the distinct and mappable parting at the top of the gray altered layer of red beds. None of the observed fault planes or slip surfaces in the Triassic red beds in the extensively mapped section cross or offset the parting. In addition, the bedding in the Antlers Formation is continuous where observable and not calichified, and in particular, developed as an erosional feature along the preferred jointing direction in the Southern High Plains. The bench projects to Baker Spring, to a notch in the topography about one-half mile northwest of Baker Spring, and parallels Mescalero Ridge, part of the Caprock escarpment to the northwest of Monument, New Mexico.

Two smaller lineaments oriented about 45° were identified by Golder Associates to the west and east of the permitted area. The westernmost 45° lineament, which is about 4000 feet in length, is a surface draw that empties into a depression at Baker Spring, New Mexico. The 45° lineament east of the permitted area is less developed. It extends through the ranch house area for a total length of about 4,500 to 5,000 feet, developing into a shallow draw southwest of the ranch house area. The north-trending lineaments identified by Terra Dynamics about 3 miles west of the WCS site in Lea County, New Mexico, may be related to tonal contrasts in the vicinity of Monument Draw, New Mexico.

The lineaments in the vicinity of the WCS facility do not have any geologic or geomorphic characteristics typical of active faults. There are no topographic shifts along the lineament, or any apparent offsets in local drainage, or any interruptions in the gradient of erosional terraces above Baker Spring (assuming Baker Spring comprises part of the lineament). The lineament in the vicinity of the WCS facility is considered to be an erosional feature.

4.2 LAND SURFACE SUBSIDENCE

This section addresses the potential for land surface subsidence due to ongoing geologic processes and human activities in the vicinity of the WCS facility. Subsidence can be defined as the sudden sinking or gradual downward settling of the earth's surface with little or no horizontal movement. Subsidence may be caused by natural geologic processes such as solution or compaction or by human activities such as subsurface mining or pumping of oil or groundwater.