SOIL MICROMORPHOLOGY AND FAULTING

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Technical Report

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The Post-doctoral research associate who worked on this study was not able to start on the project until Jan. 15, 1980. Consequently, this report deals primarily with studies initiated during the period Jan. 15, 1980 to May 1, 1980 and conclustions are tentative.

A. Investigations

1. Undisturbed samples were collected from soils across the La Jencia fault, near Magdalena, New Mexico. In a previous report (Summaries of Technical Reports, Vol. IX, p. 96) the effect of faulting on soil pores at this site was discussed. Thin sections were prepared and the effect of faulting on micromorphological structures is now under investigation.

2. It has been shown (Low et al. 1979) that the distribution of soil pores within a faulted soil is different than the distribution of soil pores in the normal soil for the area. These conclusions were derived by visual evaluation of rose diagrams of soil pores. Such visual observation may be subject to human error. Statistical parameters developed by those interested in particle morphology (Beddow and Melog, 1980a) would be useful in describing soil pore distribution.

Results

1. Figure 1 shows the soils associated with the La Jencia fault, near Magdalena, New Mexico.

The soil at this site consists of a Pleistocene paleosol, which is faulted, overlain by a holocene soil which is not faulted. Samples A, B, C, D, F, H and K were from the Bt horizon of the Pleistocene paleosol. Samples E and I were from soil breccia within the fault zones.

Figure 2 and Plate 1 show cutans in sample B. These cutans are typical for samples A, B and C. A cutan "is a modification of the

texture, structure, or fabric at natural surfaces in soil materials due to concentration of particular soil constituents or in situ modification of the plasma" (Brewer, 1960). In these samples the cutans are composed dominantly of clay minerals, and are called argillans (Brewer, 1976, p. 212). These argillans are clay minerals which have been translocated to the Bt horizon of the pre-Holocene soil at the La Jencia site. Plates 3 and 4 show the typical soil micromorphology of samples E and I. Although the paleosoil was characterized by well developed argillans, only small reminants of argillans were found in the fault zone. It must be assumed that highly oriented pedologic structures were destroyed at the time of movement of the fault.

2. Powder technology is a discipline concerned with, among other things, quantitilizing particle shape or morphology (Beddow and Meloy, 1980a, 1980b). Pryzgock (1976) used sophisticated techniques of powder technology to relate sediments to source areas, in a manner somewhat similar to the problem of identifying different populations of soil pores.

A rose diagram is a set of directional data, which should be analyzed using the techniques of vector mathematics. The equivalent of a normal distribution in a circular range (360 degrees) is called a von Mises distribution, or circular normal distribution (Till, 1974). This distribution is defined as:

$$y = \left(\frac{1}{2*I(k)}\right)\exp\ (k \cos\ (O-O_\Theta)$$

Where y is the relative frequency of observations at azimuth O.

O_O is the main or average azimuth of the distribution.

k is a parameter measuring the spread of distribution.

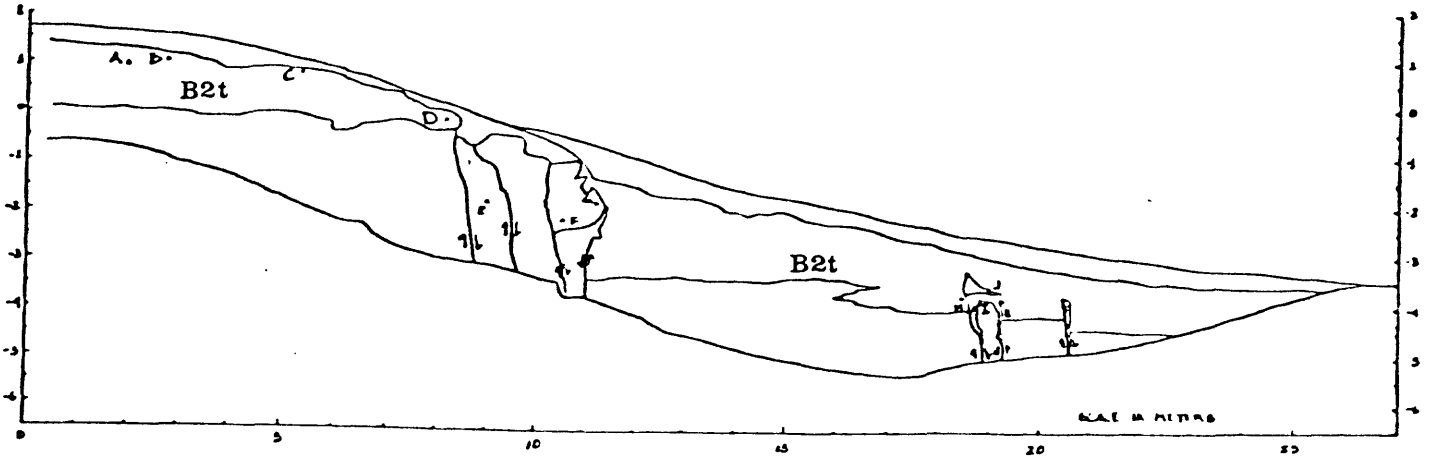

Figure 1. Soil sampling sites and La Jencia fault.

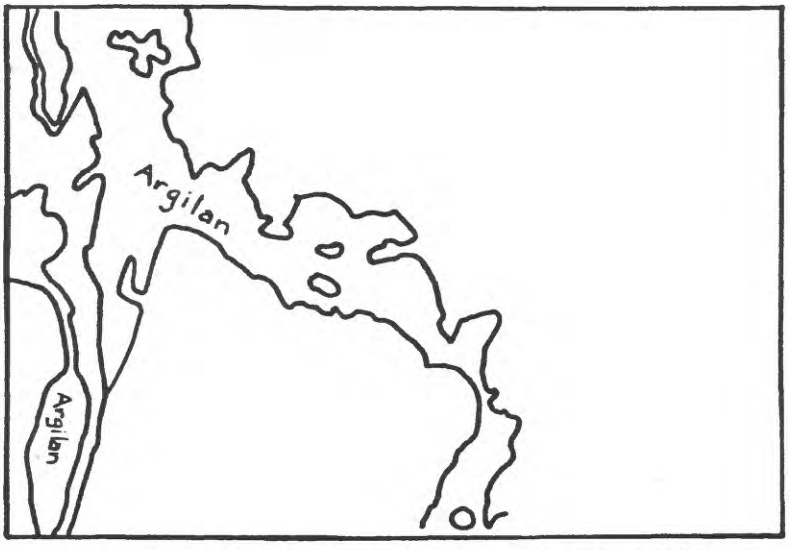

Figure 2. Argilans in sample B (X50).

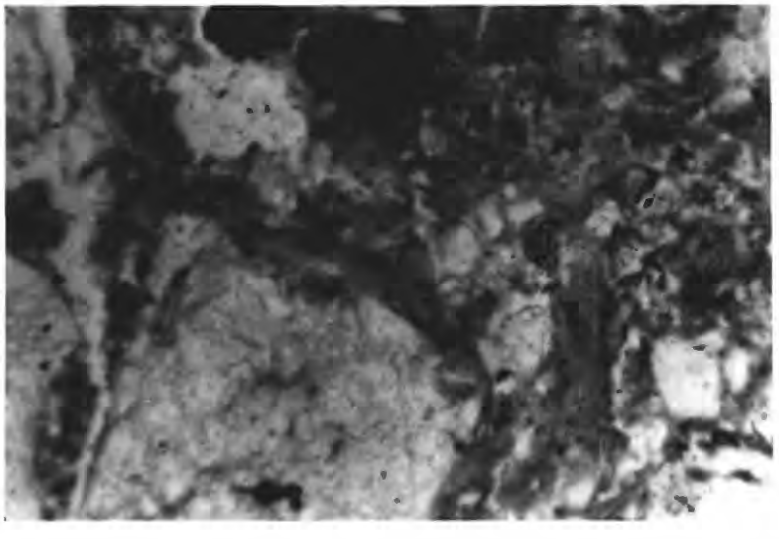

Plate 1. Photomicrograph of sample B, transmitted light (X50).

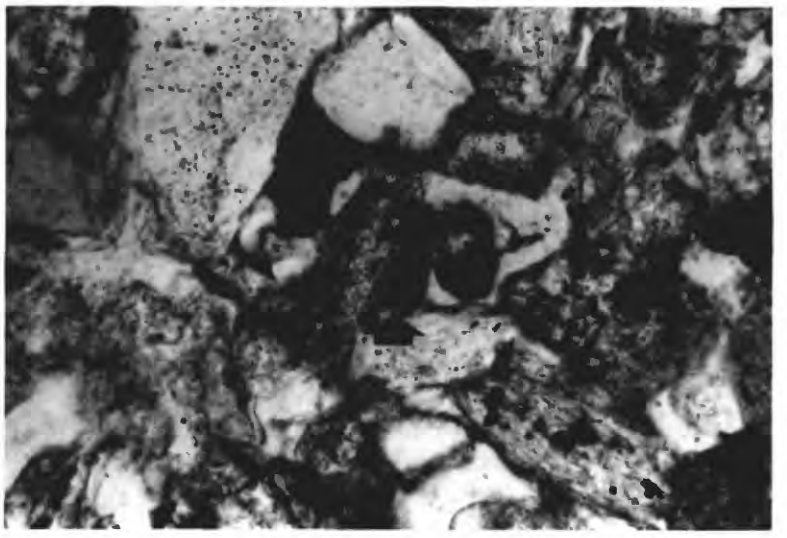

Plate 2. Remnant of an argilon (at arrow) in soil breccia, sample E, transmitted light (X50).

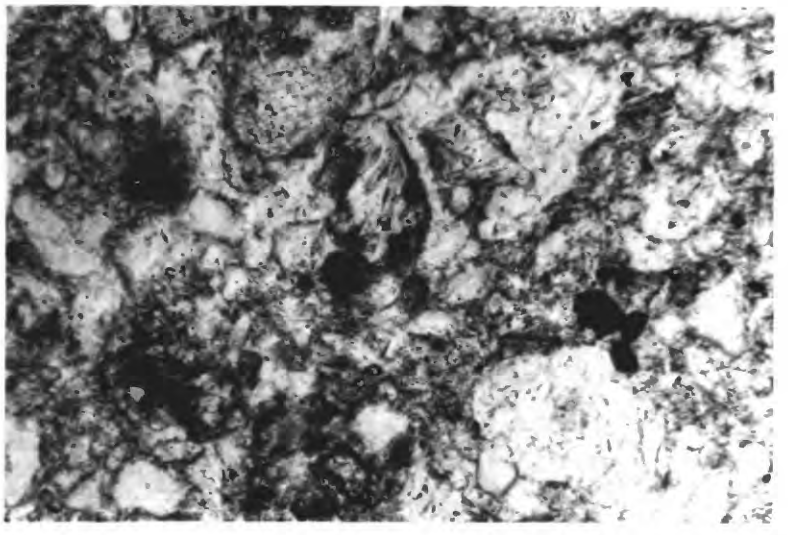

Plate 3. Soil breccia, sample I, with little evidence of pedological development, transmitted light (X50).

I(k) is a Bessel function of the first kind, by which the relative frequency of y can be normalized.

This function should enable one to statistically evaluate pore distribution with a single preferred direction. If the rose diagram does not follow a distribution with a single maxina, the rose diagram must be converted to a Fourier series and the coefficient of the series evaluated.

Conclusions

1. Initial studies of the spatial arrangement of soil constituents of a normal soil and an associated faulted soil indicate that the soil fabric may give considerable insight into the affect of faulting on soils. A detailed study of thin sections from the La Jencia site is now underway.

2. Visual analysis of rose diagrams has indicated differences between different populations of soil pores, however this technique may be subject to human error and bias. We believe we have now found techniques to quantitatively evaluate similarity between different populations of soil pores, and these techniques will be further evaluated.

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