Final report for SCEC2 investigations into the origin and distribution of pulverized rocks as a function of rock type

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Introduction

We searched for examples of pulverized rocks along faults other than the San Andreas, where the presence of pulverized granite is well established (Dor et al., 2006). In particular, we searched for areas where metamorphic, granitic, and metasedimentary rocks were co-located to investigate the role of rock type on pulverization. Towards this end, we walked portions of the San Jacinto, Elsinore, and San Miguel faults, and found pulverized granite along both the Elsinore and San Jacinto faults. We also continued development of reliable laboratory techniques, as some of the prior published results suffered from poor laboratory procedures. In this report, we present new information on pulverized granite along the San Jacinto fault (Figure 1) where there is both asymmetry across the fault in the pulverization of the granitic rocks, as well as a remarkable difference in damage between the granitic and metamorphic rocks.

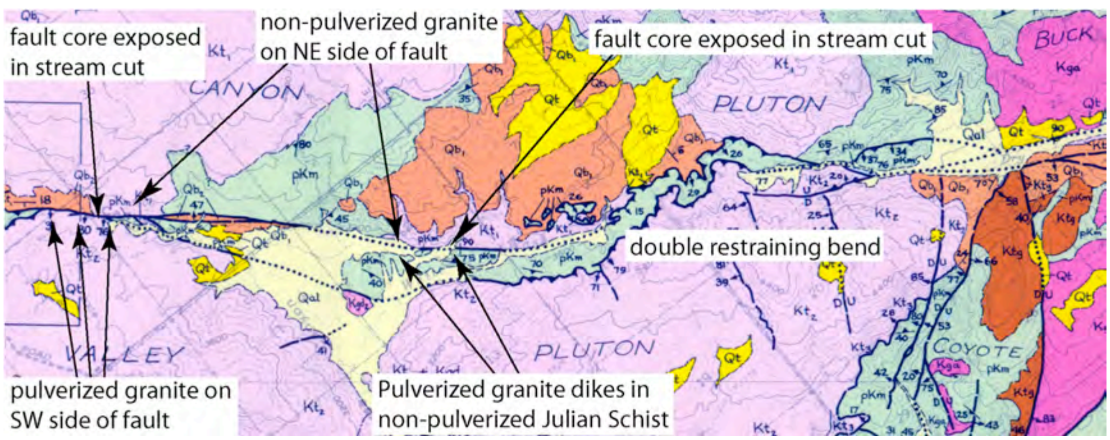

Figure 1. Geologic map of the San Jacinto fault in Horse Canyon (Sharp, 1967) with areas that show pulverization.

General Observations at Horse Canyon

We identified pulverized granite along the San Jacinto fault in the vicinity of Horse Canyon, southeast of Anza (Figures 1 and 2). The distribution of pulverization is highly asymmetric, with only the southwest side of the fault exhibiting the pulverization. On the northeast, the granitic rock (coarse-grained tonalite) is mostly undamaged to within meters of the fault core, displaying local fracturing but not pulverization (Figure 3). At very close distances to the fault core, we do observe pulverization which may locally be only a meter or less in width. In contrast, the southwest side of the fault exhibits locally extensive pulverization, with a high degree of fracturing in the tonalite (Figure 2). In contrast, the highly foliated (metamorphosed) Julian Schist does not exhibit pulverization, even where granitic dikes within the schist are highly pulverized (Figures 1 and 4). We are in the process of detailed mapping, thin section analysis and geochemical analysis to better understand this process, but there appears to be a significant difference in the response of different rock types.

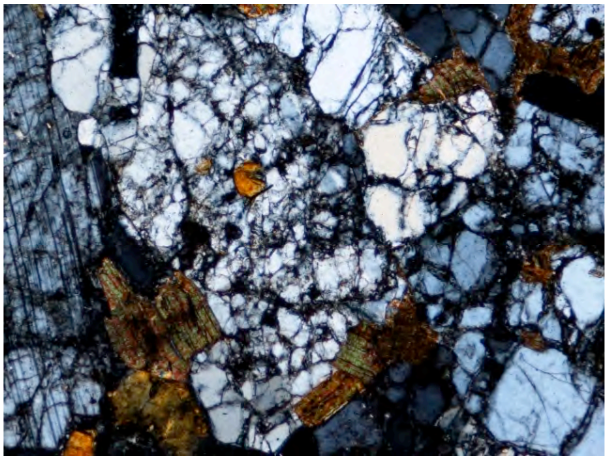

Figure 2. (left) Photomicrograph of granodiorite from a dike within the Julian Schist. The granitic rocks display intense shattering in thin section, and have a sugary pulverized texture in the field. Image is about 2 mm across.

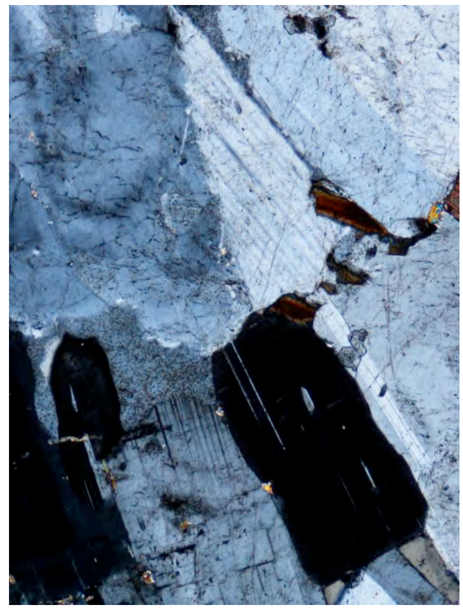

Figure 3. (right) Un-fractured coarse-grained tonalite from the NE side of the fault at White Wash. All grains maintain coherence, and the rock rings with a hammer strike in the field. The shattered grains in figure 2 started at a similar size to these. Scale is the same as in figure 2.

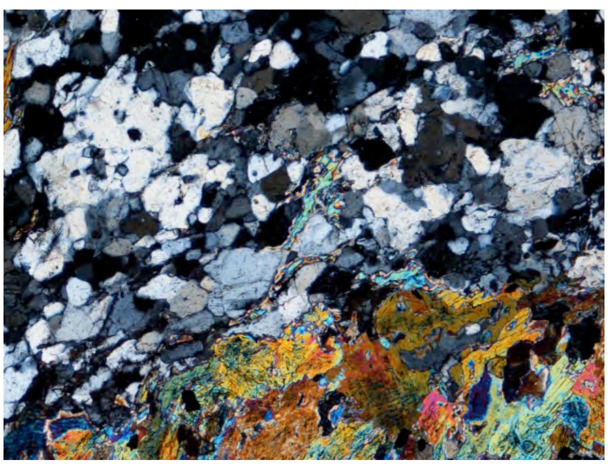

Figure 4. (left) Photomicrograph of the Julian Schist showing little to no pulverization at thin section scale. Field samples show macro-fracturing but are solid, also indicating the lack of micro-pulverization. Image is ~2 mm across.

We analyze all samples for chemical alteration by X-ray fluorescence (XRF). At this point, we have run only three samples from White Wash, two from examples of pulverized granitic rock and one from the gouge in the fault core (Figure 5). The granitic samples display no significant alteration or weathering, plotting as unweathered tonalite, whereas the analysis of the gouge from the fault core indicates substantial weathering. Based on physical inspection of the gouge, there appears to be translocated pedogenic clay incorporated in the gouge, consistent with the weathering trend. This indicates that a closer analysis of the gouge is in order as much of the very fine particles may be clay minerals, as opposed to finely comminuted quartz or feldspar.

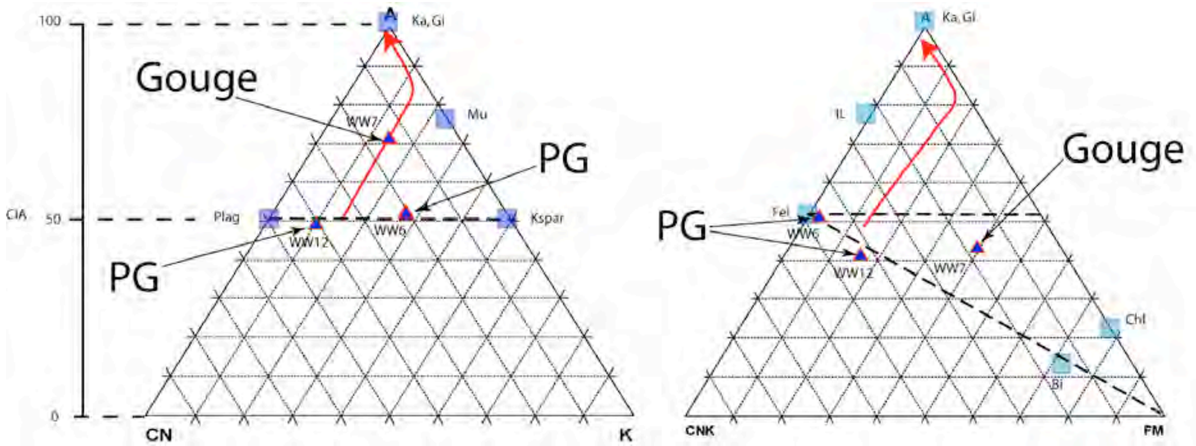

Figure 5. X-ray fluorescence analyses of two pulverized tonalite samples (PG), and one sample of gouge from the active fault core. Note that the granite samples indicate absence of chemical weathering whereas the gouge clearly contains weathering products.

Laboratory Procedures

We have spent considerable time investigating laboratory procedures for the analysis of pulverized rocks. In particular, we have run extensive comparisons between laser particle size analyzer data and classic particle-size distributions utilizing settling tubes. We have also experimented with the use of dispersing agents. In short, the prior work published by Wilson et al (2004, 2005) is not accurate, as their particle size results are largely an artifact of misuse of the analyzer. In our studies, most of the pulverized grains fall in the 10-100 micron range, consistent with microscopic analyses. We will shortly produce a detailed comparison and analysis of this work.

References Cited

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