**The Implication Of Rock Transformation On Fault Creep: An Example From The North Anatolian Fault, Turkey**

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**ABSTRACT**

Aseismic creep is found along several sections of major active faults at shallow depth, such as the North Anatolian Fault in Turkey, the San Andreas Fault in California (USA), the Longitudinal Valley Fault in Taiwan, the Haiyuan fault in China and the El Pilar Fault in Venezuela. Identifying the mechanisms controlling creep and their evolution with time and space represents a major challenge for predicting the mechanical evolution of active faults, the interplay between creep and earthquakes, and the link between short-term observations from geodesy and the geological setting.

Hence, studying the evolution of initial rock into damaged rock, then into gouge, is one of the key question for understanding the origin of fault creep. In order to address this question we collected samples from a dozen well-preserved fault outcrops along creeping and locked sections of the North Anatolian Fault. We used various methods such as microscopic and geological observations, EPMA, XRD analysis, combined with image processing, to characterize their mineralogy and strain.

We conclude that (1) there is a clear correlation between creep localization and gouge composition. The locked sections of the fault are mostly composed of massive limestone. The creeping sections comprises clay gouges with 40-80% low friction minerals such as smectite, saponite, kaolinite, that facilitates the creeping. (2) The fault gouge shows two main structures that evolve with displacement: anastomosing cleavage develop during the first stage of displacement; amplifying displacement leads to layering development oblique or sub-parallel to the fault. (3) We demonstrate that the fault gouge result from a progressive evolution of initial volcanic rocks including dissolution of soluble species that move at least partially toward the damage zones and alteration transformations by fluid flow that weaken the gouge and strengthen the damage zone.