FRICTIONAL CHARACTERISTICS OF SERPENTINITE FROM THE MOTAGUA FAULT ZONE IN GUATEMALA

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INTRODUCTION

The Motagua fault is similar to other major earthquake producing strike-slip faults in that they all contain geologically significant amounts of serpentinite. For the Motagua fault Dengo (1973) has reviewed the tectonic implications of the serpentinite, indicating that it is located within the fault zone, which is an active plate boundary.

Allen (1968) has implied that the great abundance of Fransiscan serpentinite within the San Andreas fault, between Hollister and Parkfield, may be responsible for controlling movement along that segment of the fault. Scholz (1977), among others, has brought attention to the widespread occurrence of serpentinous rock along the Alpine fault of New Zealand. He suggests that the correlation between serpentinite and seismically active areas requires that a more in depth study of the frictional characteristics of this rock be done. Furthermore, oceanic fracture zones, which exhibit seismic activity, also contain large amounts of serpentinite (Scholz, 1977; and Bonatti and Honnorez, 1976).

Thus the presence of serpentinite along active faults makes it desirable to investigate how its frictional behavior may affect movement along a fault. Unfortunately little is known about the frictional characteristics of serpentinite. Such knowledge is required if a program of earthquake prediction and control is to be effective in areas as those mentioned.

The mechanical behavior of serpentinite has been studied by Raleigh and Paterson (1965). They found that at intermediate pressures and temperatures serpentinite undergoes a transition from a strong ductile rock to a weak brittle rock. The transition is induced by the dehydration of serpentine to less hydrous phases plus water vapor. The released water vapor increases the pore fluid pressure and thus reduces the effective normal stress. Their conclusion that brittle failure takes place at shear stresses which are low compared with the total pressure in dehydrating serpentinite led them to suggest that dehydration mechanisms could be an important seismic focal mechanism in areas with abundant serpentinite. Such conclusion is in agreement with that of Griggs and Handin (1960) in which they suggest that dehydration reactions could allow for brittle fracture at depths where otherwise it would be inhibited.

In a study to characterize the sliding modes of different rock types Brace and Byerlee (1968) found that a dunite containing 3% serpentine resulted only in stable sliding. They concluded that serpentinite cannot exhibit stick-slip sliding, even at room temperature. Nevertheless, in a later study, by Summers and Byerlee (1977), it was found that a simulated gouge layer of crushed serpentinite (0.064 cm thick) placed between Westerly granite, did exhibit stick-slip sliding, at confining pressures greater than 150-300 MPa. A period of stable premonitory slip was observed prior to the stress drops.

It was in view of this uncertainty in the behavior of serpentinite and, in recognition of the significance of the problem, that this study was initiated. The sliding behavior of five blocks of serpentinite, taken from different locations along the Motagua fault zone (Figure 1), has been