Geophysical Research Abstracts, Vol. 8, 06165, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06165

The role of fluids in partitioning rupturing and plastic deformation in auriferous shear zones between 500-700˚C

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Experimental results and field studies of exhumed shear zones indicate that permeability enhancement is commonly associated with macroscopically continuous deformation. The permeability is influenced by (i) porosity-producing processes, such as metamorphic reactions and deformation, and (ii) porosity-reducing processes, such as hydrothermal precipitation and crack-healing. In this study, I present data from amphibolite facies hydrothermal lode-gold deposits in order to describe the role of fluids in the formation of macroscopic fractures.

Auriferous thrusts at Renco (Limpopo Belt, Zimbabwe) formed at 600–700˚C during shearing of granulite facies tonalitic gneisses. Locally, lensoid breccia bodies of 1-50 cm width and 1-50 m along strike and down-dip are developed. The breccias show evidence of open space fillings and hydraulic fracturing. This requires intergranular cementation, compaction, and healing and sealing of pores to provide fluid pressures high enough to facilitate fracturing. Viscous deformation of the mylonites may effectively seal lensoid bodies containing fluid in intergranular pores from the rest of the shear zone. In these compartments, the fluid pressure may reach lithostatic to supralithostatic levels and cause seismic deformation.

Amphibolite facies (500-600˚C), auriferous, vertical strike-slip shear zones ($>$ 10 m wide), which cut through amphibolites, were studied at Kochkar (Urals, Russia) and Hutti (Dharwar craton, India). The amphibolites are pervasively altered and contain a disseminated style of gold-sulfide mineralization. In Kochkar, shear zone parallel gold-quartz veins formed at amphibolite-granite contacts. Intracrystalline plastic de-

formation is not active for all minerals in amphibolites, which causes strain partitioning. Hence, a heterogeneous situation of creep and cataclasis is characteristic. Fluid conduits are produced on a grain-scale and the permeability structure of the shear zone remains open for fluids during the entire deformation event. Hydraulic fracturing is unlikely and only possible where the regional stress field is disturbed by viscosity variations of the deformed lithology, because fluid pressure build-up is hindered by a relatively high permeability and the limiting factor of possible reshear. This study suggests that not only a large fluid supply is critical to lower crustal rupturing, but also the capability of sealing and fluid pressure build-up, which is largely controled by the mineralogical composition of the mylonites, the lithological composition of the crust and the shear zone orientation with respect to the regional stress field.