STRESS CORROSION CRACK PROPAGATION AS A POSSIBLE MECHANISM FOR KIMBERLITE PIPE FORMATION

O. L. Anderson (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California 90024 U.S.A.)

The stress corrosion model is used whereby an igneous intrusion of magma within a crack is used to describe the physical processes of pipe eruption. A symbiotic relation exists between the crack and the fluid. The crack cannot go faster than the fluid within the crack can flow in the channel provided by the crack, and the speed of the fluid is limited by its own viscosity. A volatile phase at the tip of the crack at lithostatic pressures will allow the crack to accelerate to high speeds, since the viscosity of a volatile is small.

It is proposed that Kimberlite pipes occur in those rare regions of the earth where the composition of rocks at depth are rich in CO_2 compounds. A crack passing through such a region releases abundant CO_2 gas which accumulates in the tip of the crack. This provides the necessary low viscosity for the crack to accelerate. It becomes unstable, and the speed approaches the shear velocity of sound as the crack breaks through the earth's surface.