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Connectivity of fluids at the mid-crustal depths

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Geophysical explorations have been conducted to study the composition,structure and dynamics in the Earth's crust. A lot of detailed profiles of seismic velocity and electrical conductivity have been reported.

The observed electrical conductivity is generally higher than those of dry rocks by several orders of magnitude, suggesting that fluids (mostly aqueous fluids) prevail within the crust. The observed spatial variation of seismic velocity and electrical conductivity should thus reflect the distribution of fluids. Based on the velocity variation at the mid-crustal depths, the spatial variation of fluid volume fraction must be no more than a few%.

The observed spatial variation of electrical conductivity is often up to 4 orders of magnitude. This large conductivity change must occur over a narrow range of the fluid volume fraction. If the connectivity of fluid is identical, the conductivity is proportional to the fluid volume fraction. A small change in the fluid volume fraction cannot make a change of orders of magnitude. The observed large change in conductivity requires the increase of connectivity with increasing volume fraction of fluid. Such an increase of connectivity suggests that crustal fluids are generally in a critical state of interconnection.

I think that this critical state of fluid connection is self-regulated. If fluids are fully interconnected, the permeability becomes high enough to expel fluids rapidly. It leads to the decrease of interconnection, and to the decrease of permeability. If fluids are supplied from depths, the fluid is accumulated there to increase the permeability.

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