Permeability of the continental crust – Experimental study and insight from the petrological and seismological data

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Permeability is one of the key properties governing the fluid regime, mass and heat transfer in the continental crust. The results of the laboratory experiments show that the values of rock permeability can change by decimal orders due to the effect of high temperature and pressure. In general it was found that permeability of the continental crust rocks decreases with depth. In contrast, it increases at PT-parameters of progressive metamorphic transformations.

The results of petrologic studies reveal both the marks of long periods of very low permeability and events of high permeability.

The conception when long periods of low permeability are coupled with short periods of high permeability is supported by seismic data. The burst of hypocenters clouds to the Earth surface and/or their systematical movement up to the Earth surface are found using the data of the earthquakes localization. Identification of such events with front of fluid propagation allows to estimate high permeability values as ($>10^{-13}$ m^2).

However, the mechanism of permeability increase in low and mid-crust is unclear. Moreover, we suggest that some episodes of the crust permeability increase could be related to the positive feedbacks, between microcrack initiation due to rock metamorphic transformations resulting in increase of permeability and active deep fluid infiltration which in its turn accelerates the rate of metamorphic transformations.

Iron and sulfur speciation of sliding mud from Xieliupo Landslide in South Gansu Province, NW China

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Gray and/or black mud materials are often observed within many slipping zones of landslide, especially those landslides in large scale and long history of action, which are always known as sliding mud and considered as a key factor corresponding to landslide development and even the slipping actions. The sliding mud is attractive to many researchers and engineers working on landslide protection. However, there is still a large space to understand the formation mechanism and accumulation process of sliding mud. There are several famous landslides with thick layers of sliding mud in the Longnan district, south part of Gansu province, NW China. In order to check the possible relationship between the sliding mud properties and landslide development, 13 samples were collected from one vertical profile cross the sliding surface of the Xieliupo Landslide and analyzed for their mineral and chemical compositions as well as chemical species of iron and sulfur using XRD, XRF, and Mössbauer spectroscopy and K-edge XANES, respectively. The mineral and chemical composition of the samples showed the sliding mud was different from both the upward debris rock and beneath bedrock, being agreed well with their surface properties such as color and partial sizes. Mössbauer spectroscopy revealed a clear variation of iron species between the sliding mud and the debris and bed rocks. The sliding muds contain much more ferrous iron than the sliding (the debris) rocks and the bedrocks, indicating a relatively stronger reducing condition within the slip zone. In addition, the sliding mud in darker colors near the sliding surface showed much more ferrous iron than the sliding mud in light gray color relatively far from the sliding surface. K-edge XANES also revealed the vertical variation of sulfur species that was similar to iron speciation, the slip zone was enriched with reduced sulfur species and the debris and bed rocks contain relatively much more oxic sulfur species. All data of mineral and chemical composition, and also iron and sulfur species revealed a relatively reducing condition in the slip zone. Such a reducing condition could be favored for the gray and/or black mud materials precipitated and accumulated, and furthermore resulted the weakness of sliding zone along with the process of landslide development.

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