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Magnetofabrics of ultrahigh-pressure gneisses from the Chinese Continental Scientific Drilling (CCSD) project: Retrogression of ferromagnetic gneisses

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In order to better understand retrograde processes during exhumation of ultrahigh pressure (UHP) rocks the anisotropy of magnetic susceptibility (AMS) was measured on UHP-gneisses from the 5138 m deep CCSD-mainhole. The Sulu UHP-gneisses are composed of variable proportions of quartz, K-feldspar, plagioclase, biotite, and white mica with variable contents of garnet, chlorite, epidote, amphibole, and accessory phases such as zircon, apatite, and Fe-Ti-oxides.
111 samples from 21 oriented core pieces from the uppermost 1800 m of the CCSD-mainhole were measured for their AMS. The mean susceptibilities (Kmean) of the gneisses vary from 0.1x10-3 to 37.2x10-3 SI. Some core pieces outline a large intra-sample variation of Kmean. The anisotropies (P´) of the gneisses vary from 1.05 to 1.62. 83% of the samples display positive shape factors (T) and thus oblate AMS-ellipsoids. Magnetic foliations coincide with metamorphic foliations dipping to the ENE with variable dip angles. The orientations of the principal susceptibility axes show no systematic variation with Kmean at the intra- and inter-sample scale. The average gneiss density is 2.67$\pm$0.12 g/cm3. The main carrier of susceptibility is biotite for the paramagnetic gneisses (Kmean < 0.5x10-3 SI) and magnetite for the ferromagnetic gneisses (Kmean > 5x10-3 SI). Variation diagram of Kmean versus density outlines a well-constrained positive correlation for paramagnetic gneisses since higher contents of biotite augment both density and Kmean. For the ferromagnetic gneisses the correlation is also well constrained and positive since higher contents of magnetite augment both density and Kmean. Cogenetic gneisses with a large intra-sample variation of Kmean are in particular suitable to better understand possible genetic links between the para- and ferromagnetic gneisses. These particular samples outline diffuse, but nevertheless negative correlations between Kmean and the density corroborating decomposition of magnetite and concomitant biotite formation. Since no impact on the orientation of the AMS-ellipsoids is observed magnetite decomposition took place during or after the major ductile deformation phase. This can be well documented by SEM imaging, which shows fractured magnetite with newly grown biotite and magnetite inclusions in biotite. AMS data may thus be better interpreted as tracing retrograde fluid-induced decomposition of magnetite and concomitant biotite growth rather than primary compositional variation.