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Reactivation of Paleoproterozoic crust in southern Finland based on paleomagnetic studies of shear zones

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Paleomagnetic and mineralogical studies have been carried out on Paleoproterozoic crystalline rocks in shear and fault zones in southern Finland. That was done to obtain further evidence on Proterozoic-Paleozoic reactivation of the crust due to juvenile fluid activity. Locating in the central part of Baltica, the area has been tectonically relatively quiet since Precambrian, but previous paleomagnetic studies from the same region have shown presence of remagnetization events.

The oldest identified remanence component represents primary magnetization, referring to the late stages of Svecofennian orogeny at ~1.85 Ga. According to the SEM and rock magnetic studies the remanence resides in (titano)magnetite. Younger Proterozoic component is related to the ~1.6 Ga rapakivi intrusions.

The most prevalent remanence represents Permian remagnetization, carried by fine-grained hematite. We presume this component reflects reactivation of the Svecofennian crust either due to (i) spreading of basinal fluids caused by tectonic processes at the edges of the plate (Caledonian, Hercynian and Uralian orogens) or (ii) extensive erosion/regression that allowed subsurface meteoric fluids to circulate in the already existing fault systems. The likely source for iron in these fluids could be the processes of alteration and dissolution of micas, epidote and/or earlier iron-titanium oxides. Additional iron could also have been transported into the system by externally derived fluids. Solving the exact origin of fluids still needs geochemical analysis of fluid inclusions and studies on isotopic compositions.

In a wider view all these tectonic events can be related to the formation and break-up of supercontinent Pangea. Worldwide, there exist hundreds of documented indications of a late Paleozoic secondary magnetization in different rock types. Similar secondary magnetizations have been found also in the Fennoscandian region, for instance in the crystalline rocks in eastern and northern Finland, in southern Sweden, and in sedimentary rocks of north-western Russia and Estonia. Usually the events that are regarded to be the source for this remagnetization have been related to some local or regional processes. However, the concurrent Permian remagnetization of the studied region with worldwide tectonic and deformation events indicates that global late Paleozoic tectonism can be the major catalyst for fluid flow and consequently, the principal cause of remagnetization.