Results of Paleomagnetic Study in the Vihorlatské vrchy Mts (East Slovakia)

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The Vihorlatske vrchy Mts. is a range of andesite stratovolcanoes. They belong to the arc type basaltic andesite to andesite volcanics situated very close to the assumed subduction zone of the Outer Carpathians and being parallel to it (Lexa et al., 1993). The oldest volcanics of the Vihorlatské vrchy Mts. are those of the Vinné Complex (Late Sarmatian, 11,95 Ma) and the extrusive rhyodacite body Beňatinská voda of the same age (12 Ma). The above laying stratovolcanoes as Sokolský potok, Morské Oko, Popriečny are younger and more or less contemporaneous lasting in time from the Late Sarmatian to Pannonian (11,9–10,0 Ma).

The andesites of Vinné Complex according to the paleodeclination measured have been CCW rotated by 25–26° (road cut at Vinné, Trnava pri Laborci – castle hill) and Beňatinská voda Rhyodacite extrusive body by 30°.

The other measured andesites are not rotated or slightly CW rotated. The Sokolský potok Stratovolcano is radiometrically dated to 10,2–10,9 Ma. The andesite belonging to those stratovolcano sampled at the Jovsa village is not rotated at all (1° CW). The Popriečny Stratovolcano is radiometrically dated to 10–11,6 Ma an the andesite lava flow sampled at Podhoroď village was CW rotated by 7°. The radiometric age of Morské Oko Stratovolcano is of 9,4 to 11,9 Ma. The lava flow of the stratovolcano sampled at the village of Zemplínske Hámre was not rotated (0°). Another lava flow of the same stratovolcano sampled south of the Morské Oko Lake has been CW rotated by 17°.

From the paleodeclination data follows the Vihorlatské vrchy Mts. have been CCW rotated after the Sarmatian. Younger volcanics, Pannonian in age are not rotated, or slightly CW rotated. This is in a good agreement with the concept of the East Slovakian Basin Neogene rotations (Marton et al., 2000). The Vihorlatské vrchy Mts are situated at the NE basin margin.

A New Natural LPO Type of Clinopyroxene: Evidence from EBSD Study of Eclogite Xenoliths from Kaapvaal Craton, South Africa

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Introduction of EBSD method during nineties allowed detailed measurement of lattice-preferred orientation (LPO) of clinopyroxene, a principal mineral of "orogenic eclogites", naturally deformed between 500° and 900 °C in order to characterize rheology and petrophysical properties of subducted oceanic crust. The L- and the S-type of clinopyroxene LPO have been described for the first time in eclogites from xenolith suite of Colorado plateau kimberlites that have textural and mineralogical characteristics similar to those of eclogites from glaucophane schist terrains (Helmstaedt et al., 1972). The L-type is characterized by [001] axes, which lie parallel to the lineation and (010) poles in the plane normal to the lineation, whereas S-type shows [001] axes form girdle in the foliation plane and (010) planes are parallel to the foliation. Beside transitional types of LPO between the L- and S-type, there was not observed different LPO in omphacite (e.g. Van Roermund, 1983; Goddard and Van Roermund, 1995, Bascou et al., 2001). The LPO of clinopyroxene from "mantle eclogites" that was taken up to the surface by kimberlitic eruptions from the litospheric upper mantle has not been studied, yet. In this work, we present LPO of natural clinopyroxenes from six eclogite nodules taken up to the surface by kimberlite eruptions in the Kaapvaal craton, South Africa. Five nodules were sampled in the Roberts Victor mine, and the last one came from the Premier Mine. PT estimates has been performed on every nodule in order to characterize metamorphic conditions of the LPO development. Generally, there are two groups of samples that show distinctly different microstructure, LPO of omphacite (one of them is unknown) and corresponding PT conditions of its development.

Group 1:

Sample HRV277 is coesite + kyanite + sanidine eclogite of medium-grained microstructure with elongated garnets defining foliation. HRV113 shows coarse-grained microstructure with regular distribution of rounded garnet grains and clinopyroxenes. The sample HRV1300 show solid-state coarse-grained deformation fabric with foliation defined by regular distribution of elongated garnet crystals with clinopyroxenes. Omphacite LPOs are similar to the L-type (HRV277) and LS type (FRB1300, HRV113) pattern defined by Helmstaedt et al. (1972). Presented LPOs of omphacite show preferred activity of (110) and (010) slip planes with a common slip direction [001]. Microprobe analysis showed that all three samples belong to the Group I eclogites (according to average content of K_2O_{cpx} and Na_2O_{grt}) formed under conditions similar to those required for diamond genesis (≥4.5 GPa in the cratonic geotherme). Sample FRB1300 show higher temperatures than sample HRV113 range from 1088° to 1116 °C, and from 962° to 991 °C, respectively. The sample HRV277 shows the highest temperatures of equilibration between 1130ºC and 1145ºC (Ellis and Green, 1979; Powell, 1985; Ai, 1994).

Group 2:

Xenoliths KBRV4 and HRV58 showed coarse-grained solid-state deformation fabric with the higher content of garnet in the latter one. Clinopyroxenes show large originally interconnected grains that surround strongly elongated garnet grains. A sample JJG6 shows coarse-grained microstructure with regular distribution of slightly elongated garnet grains and surrounded clinopyroxenes. The sample KBRV4 show the most complex LPO pattern, that can be used to described major families of grain orientations. The family I show the strongest maximum of [100]-axes oriented normal to the foliation plane and weak maximum for [001]-axes declined 20° from the lineation in the margin of the pole figure. The families I and II show common and very strong maximum of (010)-planes in the center of the pole figure. The family II shows the strongest maximum for [001]-axes and weaker for [100]-axes declined 50° from the lineation localized in the opposite margin of the pole figures, respectively. Applying this subdivision of grain families on LPO of other samples, JJG6 show only two families I and II, and HRV58 show unique family II. Described positions of main lattice planes and axes show neither L nor S-type pattern defined by Helmstaedt et al. (1972). Microprobe analysis showed that both samples belong to the Group II eclogites (according to average content of K_2O_{cpx} and Na_2O_{grt}) formed out of conditions required for diamond genesis (≤4.0GPa). Sample KBRV4 show the highest equilibration temperatures ranging from 873° to 931 °C, while the sample JJG6 shows values between 855° and 889 °C, and HRV58 shows the lowest between 782° and 849 °C.

Presented LPO in Group 1 eclogite are in clear contradiction to the cation-ordering model of Brenker et al. (2002) who would expect S-type of LPO of omphacite in these temperatures and composition. Numerical simulation has been done in order to explain development of unique LPO observed in Group 2 eclogites. The most common as well as less abundant slip systems discovered in TEM work in omphacites has been used in numerous runs with a different values of activity for individual slip systems. However, the modeled LPO has never reached natural patterns, especially position of the (010)-poles in the center of the pole figure. We concur with the conclusion of Bascou et al. (2002) that the LPO type of omphacite depends on strain symmetry and operative recrystallization mechanism resulting from deformation regime and tectonic history, respectively. Thus, the new type of LPO the most likely corresponds to grain boundary migration during high-temperature dynamic recrystallization of omphacites that have never been observed in "orogenic" eclogites cropping out in mountain belts. Finally, the new LPO might also suggests activity of the new slip system that was not observed in omphacite, yet.

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