



## Microstructure evolution of plagioclase-hosted Fe-Ti-oxide microinclusions in oceanic gabbro

Olga Ageeva<sup>1,2</sup>, Olga Pilipenko<sup>3</sup>, Alexey Pertsev<sup>2</sup>, and Rainer Abart<sup>1</sup>

<sup>1</sup>University of Vienna, Department of Lithosphere Research, Althanstraße 14 (UZA II), 1090 Wien, Austria

(olga.ageeva@univie.ac.at)

<sup>2</sup>Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry RAS, Staromonetny per., 35, 119017, Moscow, Russia

<sup>3</sup>Schmidt Institute of Physics of the Earth RAS, Bolshaya Gruzinskaya str., 10-1, 123242, Moscow, Russia

Microinclusions of Fe-Ti-oxides in rock-forming plagioclase are protected from subsea-floor alterations by the silicate matrix and are stable carriers of the paleomagnetic record of oceanic gabbros. We studied plagioclase-hosted microinclusions in oceanic gabbro (“gabbro 1241” from the Vema Lithospheric section, Mid-Atlantic ridge, Pertsev et al., 2015) with a complex petrogenetic history. Important events in the gabbro evolution caused consecutive transformations of the micro-inclusions and presumably affected their paleomagnetic records.

The earliest generation of the microinclusions was present as ulvospinel and presumably titanomagnetite which were probably formed by sub-solidus oxidation exsolution of early-magmatic plagioclase (An#42-45). An increase of the anorthite component around the early generation of microinclusions to typical values of late-magmatic plagioclase (An#53) suggest involvement of the late-magmatic fluid accompanying residual melt at 800-900°C (Pertsev et al., 2015). Subsequently, the gabbro was locally affected by hydrothermal alteration at about 600°C as a result of interaction of the gabbro with reduced brine containing 20-21% NaCl. The reducing conditions of this process ensured a “non-oxidative” character and primarily cooling driven exsolution of the microinclusions and transformation of the titanomagnetite microinclusions into ulvospinel-magnetite (“Usp-Mt<sub>1</sub>”) intergrowths at about 500°C, which is close or higher than the Curie temperature (T<sub>c</sub>) of the exsolving titanomagnetite but lower than the T<sub>c</sub> of the newly forming Mt<sub>1</sub>, and the acquired magnetisation may be referred to chemical remanence. The further evolution of the micro-inclusions correlates with low-temperature hydrothermal alteration induced by inflow of seawater-derived fluids during tectonic unroofing of the lithospheric section (Pertsev et al., 2015). The homogeneous ulvospinel inclusions and ulvospinel of the “Usp-Mt<sub>1</sub>”-inclusions were replaced by “Ilm-Mt<sub>2</sub>” -aggregates under more oxidizing conditions:  $3 \text{Fe}_2\text{TiO}_4(\text{Ulv}) + 0.5 \text{O}_2 = 3 \text{FeTiO}_3(\text{Ilm}) + \text{Fe}_3\text{O}_4(\text{Mt}_2)$ . The Mt<sub>1</sub> was more stable to increase of fO<sub>2</sub> that resulted in simultaneous presence of the “Ilm-Mt<sub>2</sub>”, “Mt<sub>1</sub>/Ilm-Mt<sub>2</sub>”- and “Usp-Mt<sub>1</sub>” -inclusions with two generations of magnetic phases (magnetite) within a single plagioclase grains.

Thus, despite of protection by silicate matrix the microinclusions of Fe-Ti-oxides in rock-forming plagioclases evolve under the influence of petrogenetic processes. It is important to note that bulk-

rock AF demagnetization of 14 specimens (extracted from "gabbro-1241") in the interval 100-250 Oersted (Oe) and 300-700 Oe revealed both moderately-grouped ( $k=27.4$ ) and variable (deviated with angle  $40-104^\circ$ ) directional components of magnetisation, which may have resulted from the presence of different generations of magnetite. Further magnetic investigation of separates of plagioclase single grains will allow to evaluate capacities of plagioclase-hosted Fe-Ti-micro-inclusions to save initial and "newfound" paleomagnetic information and to serve as stable sources of paleomagnetic record in regions of mid-oceanic ridges.

Funding by RFBR project 18-55-14003 and FWF project I 3998-N29 is acknowledged.

Pertsev, A. N., Aranovich, L. Y., Prokofiev, V. Y., Bortnikov, N. S., Cipriani, A., Simakin, S. S., & Borisovskiy, S. E. (2015). Signatures of residual melts, magmatic and seawater-derived fluids in oceanic lower-crust gabbro from the Vema lithospheric section, Central Atlantic. *Journal of Petrology*, 56(6), 1069-1088.