

P-T evolution of the Precambrian mafic rocks hosting the Varena iron ore deposit in SE Lithuania

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The Precambrian Varena iron ore deposit in the western East European Craton, near the Latvian-East Lithuanian and Middle Lithuanian domain boundary, is buried beneath 210–500 m thick sediments. It consists of variable metasomatic rocks, mostly Mg-Fe skarns, associated with dolomitic marbles, magnetite and other ores. Metasomatites are hosted by metamorphosed igneous (mostly mafic) and sedimentary rocks and crosscut by later granites and diabase dikes.

Three samples of altered mafic rocks (D8-3, D8-4 and D8-6) were chosen for PT estimations.

D8-3 sample (582.5 m) is a coarse-grained metagabbro near a metasomatic K-Mg hastingsite rock. It consists of diopsidic pyroxene, edenitic and actinolitic hornblende, plagioclase (An₂₂₋₁₅) and scapolite with minor titanite, chlorite, apatite and talc. Diopside compositions range from iron richer (Mg# 0.64, jadeite component of 0.027) to magnesium richer (Mg# 0.89, jadeite less than 0.01). Amphiboles vary from primary Mg-hastingsitic (AIVI 0.38 apfu, Mg# 0.70) to secondary edenitic (AIVI 0.25, Mg# 0.72) hornblende. Plagioclase is slightly zoned, cores more calcium-rich (An₂₂₋₂₀) than rims (An₁₈₋₁₅).

Sample D8-4 (588 m) has similar mineral and chemical compositions, but is somewhat more altered than the D8-3 sample. Plagioclase in diopside is more anorthitic (An₃₂₋₃₀), while matrix plagioclase is more albitic (An₂₇₋₂₀). Sample D8-6 (710 m) is composed of diopside, plagioclase, scapolite, Mg-hornblende and actinolite. Diopside has Mg# of 0.77-0.84 and jadeite component of 0.01-0.02. Amphibole compositions range from Mg-hornblende (Mg# 0.64-0.7, Al VI 0.2-0.17 apfu) to actinolite (Mg# 0.76-0.83, Al VI 0.12-0.10 apfu). Plagioclases are An₁₈ in cores and An₁₀ at rims.

Diopsides with the lowest Mg# and highest jadeite components, together with plagioclase cores were used for PT calculations by the winTWQ software (Berman, 1991). Temperatures of 530° C and 550° C and pressures of 6.3 and 6.1 kbar were estimated for the D8-3 and D8-4 samples, respectively. Edenitic (D8-3 and D8-4) and Mg-hornblende (D8-6) and plagioclase rims were used for thermobarometric calculations (Holland and Blundy, 1994 etc). The sample D8-3 yielded 690° to 600° C and 5.6 to 4.6 kbar (4.3 kbar pressures at maximum temperature). Similar results (675-716° C and 4.1-5.5 kbar, 4.9 kbar pressures at maximum temperature) were obtained from the D8-4 sample. The sample D8-6 produced somewhat lower values of 669-532° C and 3.7-1.0 kbar.

The D8-3 gabbro may belong to the surrounding c. 1.84 Ga (Bogdanova et al., 2015) Raudamons complex. The gabbros were later metamorphosed at 550°C and 6.3 kbar (peak by clinopyroxene-plagioclase assemblages). A slight decompression to 5.0-4.3 kbar and reheating to c. 700°C (hornblende-plagioclase assemblages) were likely caused by the fluid influx and metasomatism. Such hornblende yielded c. 1.62 Ga age in the neighbouring 982 drilling (40Ar/39Ar age; Bogdanova et al., 2001). The later retrogression to 530°C at c. 3 kbar coincided with the hornblende closure temperature presumably at 1.47 Ga as was recorded in the same 982 drilling.

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