Genetic Problem of Quartz in Titanium Minerals in Paleoplacers of Middle Timan

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Abstract. Titanium ore in the Devonian paleoplacers of Middle Timan is predominantly represented by leucoxene, less frequently by modified ilmenite (pseudorutile). Other titanium minerals are found in small amounts (or have a sharply subordinate significance). All titanium minerals have numerous inclusions of quartz, which create an intractable problem in the enrichment of titanium ore. Metamorphogenic porphyroblastic explains the presence of quartz in titanium minerals. Precambrian seric-chlorite clay weathering crusts are a supplier of titanium minerals Timan. Leucoxene and ilmenite form in paraschist under conditions of facies of green shale of regional metamorphism, poikiloblasts. In the poikiloblasts, the poikilite and helicitic structures are well defined, due to numerous poikilite inclusions of quartz. The poikiloblasts, poikilite and heliic structures are well represented, due to the numerous poikilite incorporating quartz.

Keywords: Titanium · Paleoplacer · Shale · Poikiloblastez · Leucoxene · Ilmenite

1 Introduction

The main resources of titanium in Russia are concentrated in identified (Pizhemskoe and Yaregskoye deposits) and are designed (Vodnenskoe and other manifestations) of the Devonian titanium paleoplacers Timan. Ores are represented by leucoxene, to a lesser extent altered under exogenous conditions by ilmenite (pseudo-ethyl). Ore is difficult to enrich due to the large number of quartz inclusions in titanium minerals. A large number of quartz inclusions in titanium minerals is an exceptional feature of Timan paleoplacers. The high content of quartz in titanium minerals is explained by its primary metamorphogenic genesis. Slates of the Precambrian folded basement of the Timan are the root source of titanium minerals. Titanium paleoplacers are formed due to the redeposition of the weathering crust on shale (Kochetkov 1967; Kalyuzhny 1972; Makhlaev 2006; Ponaryadov 2017).

2 Methods and Approaches

Photos of minerals were taken on a JSM-6400 scanning microscope with a Link ISIS-300 energy-dispersive spectrometer and a polarized microscope.

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3 Results and Discussion

Titanium minerals - ilmenite and leucoxene (rutile, anatase and quartz aggregate) crystallize the parachale under the conditions of regional metamorphism of the green slate facies. This process is widely developed in the Riphean schists of Timan. The content of titanium minerals varies from 1.5–3.0%, occasionally rising to 5%. Titanium minerals crystallize in the form of porphyroblasts saturated with numerous quikilic poikilite inclusions. Poikilite inclusions of quartz are fragments of aleurite sizes. The quikite and inclusions of quartz and sericite captured during porphyroblasty determine the helicocyte structure (Fig. 1a, b). Titanium minerals are easily separated from shale and are separated during physical and chemical weathering. They accumulate due to gravitational separation during transportation and redeposition of weathering products. In paleoplacer metamorphic structures of titanite in titanium minerals are well preserved (Fig. 1d, f). In titanium minerals, fragments of quartz veins recorded with the growth of titanium minerals are diagnosed in paleoplacer. Sometimes fragments of sericite-chlorite schists with ilmenite grains are found (Fig. 1e). The quartz inclusions in leucoxene upon lithification of the ore-bearing sandstone can be regenerated with an increase in the volume of inclusions. The amount of SiO_2 in titanium minerals in bedrock - shale is 6.6–11.47%, and in paleoplacer - 12.2–28.19% (Ignatiev 1997). The high content of silicon dioxide in the titanium minerals of paleoplacer Timan is a specific feature of ore in this area and is explained by the metamorphogenic porphyroblastic genesis. For comparison, the SiO_2 content in titanium minerals of another well-known Tuganov paleoplacer in Western Siberia is given: silica is 1.82% for

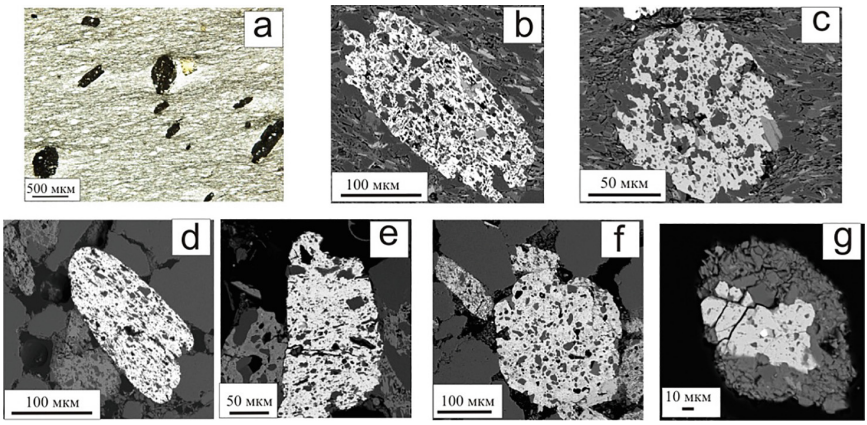

Fig. 1. Titanium minerals in shale and paleoplacers: a - leucoxene porphyroblasts in Riphean sericite-chlorite shale; b - helicitic structure in cross section of leucoxene porphyroblast in schist; c - poikilite inclusions in the longitudinal section of porphyroblast ilmenite in schist; d - helicitic structure in cross section leucoxene plate from paleoplacers; e - helicitic structure in leucoxene from paleoplacers; f - a longitudinal section of ilmenite with poikilitite inclusions of quartz from paleoplacers; g - a rounded fragment of sericite-chlorite shale with the inclusion of ilmenite from paleoplacers

ilmenite and 8.5.4% for leucoxene 6.5. The primary metamorphogenic nature of titanium minerals in Timan is indirectly indicated by the same increased content of MnO in porphyroblasts of leucoxene and ilmenite in native shale (2.5–3.63%) and in paleoplacer (to 2.33%).

4 Conclusions

The presence of a large amount of quartz in the titanium minerals of the paleoplacer Timan is explained by the porphyroblastic growth of shales under conditions of regional metamorphism of ilmenite and leucoxene. The increase in the percentage of silica in titanium minerals is also due to the processes of lithogenesis.

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References

Ignatiev VD, Burtsev IN (1997) Timan's leucoxen: mineralogy and technology issues. Science, St. Petersburg 215 p

Kalyuzhny VA (1972) Geology of new placer formations. Science, Moscow 263 p

Kochetkov OS (1967) Accessory minerals in the ancient strata of Timan and Kanin. Science, Leningrad 200 p

Makhlaev LV, Golubeva II (2006) Ilmenite-containing metapelites as the most important source of the formation of giant and supergiant titanium placers. Titanium-zirconium deposits of Russia and prospects for their development. Moscow, IGEM RAS, pp 39–42

Ponaryadov AV (2017) Mineralogical and technological features of ilmenite-leucoxene ores of Pizhemskoe deposit, Middle Timan. Vestnik of the Institute of Geology, Komi SC UB RAS, no 1, pp 29–36. https://doi.org/10.19110/2221-1381-2017-1-29-36. (in Russian)