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Interaction of seawater with (ultra)mafic alkaline rocks—Alternative process for the formation of aegirine

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Abstract

Submarine mafic and relatively Na-poor alkaline rocks in the Outer Carpathians often contain aegirine, a sodic pyroxene usually found in differentiated alkaline rocks. Its presence in rocks that are too basic and Na-poor for its conventional magmatic appearance is linked to sodic alteration of submarine alkaline rocks. Aegirine crystals grow on altered rims of diopside, commonly with crystallographic unconformity, suggesting that their growth was related to alteration and that aegirine does not represent a late stage of continuous clinopyroxene crystallization. The U-shaped REE patterns in the studied aegirine lack Eu anomaly, characteristic for aegirine from differentiated alkaline rocks. Therefore, the involvement of chemically more evolved magma is unlikely to have played any role in the formation of aegirine in ijolites and essexites. Formation of aegirine in submarine alkaline rocks may thus represent an alternative process to spilitization. However, this process is strongly limited by the availability of Fe^{3+} oxidized and mobilized by hydrothermal alteration, which may explain a relative scarcity of aegirine observed in submarine alkaline rocks compared to near-complete albitization of spilites, and its absence in high-MgO rocks (>10 wt%). Due to the blocking effect related to Fe^{3+} unavailability, ijolites, and essexites do not display significant Na enrichment. We posit that Na incorporated in aegirine was mainly sourced from the zeolitized interstitial glass.

Keywords: Aegirine, sodic metasomatism, pyroxene recrystallization, submarine alkaline rocks, teschenite