New occurrences of non-classical pyriboles formed during ocean-floor and regional metamorphism: estimated PT conditions of formation

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Abstract: Since the discovery of triple-chain silicates (TCS), there has been much interest in pyribole structure types. Here, new occurrences of non-classical pyriboles which were formed during ocean-floor and regional metamorphism are described.

Disordered pyriboles resulting from ocean-floor metamorphism in the Marianas Trench are compared with disordered pyriboles from the Shimokawa dolerite. Based on the mineral paragenesis and previous discussions of the Shimokawa district, the formation temperature of disordered pyriboles is estimated to be 250-500°C. The pressure is not known precisely, but is probably not very high in an ocean-floor environment (< 5 kbar). Coarse-grained orthorhombic, non-classical Mg, Fe-pyriboles (jimthompsonite and chesterite) are very widely distributed in regionally metamorphosed rocks from three localities (Widgie 3, Mariners and Kambalda) in western Australia. These minerals occur as prismatic porphyroblasts of up to 30 mm long in talc-chlorite schist. The change from the pyribole to the tale structure was investigated by HRTEM, which shows that various types of defects played an important role in the early stage of transformation in these samples. Based on mineral paragenesis, textures and literature data of experimental results, non-classical pyriboles from western Australia are estimated to have formed under conditions of high \( X_{\text{CO}_2} \) (e.g., \( X_{\text{CO}_2} > 0.8 \) at \( P_{\text{total}} = 2 \) kbar), up to temperatures of approximately 600°C. Coarse-grained, monoclinic, non-classical Mg, Fe-pyriboles (clinojimthompsonite and "clinochesterite") occur in cummingtonite-biotite schist at Norseman, western Australia.

Considering all natural formation conditions and previously reported experimental results, the P-T formation conditions for non-classical pyriboles, even in disequilibrium processes, are empirically estimated to be \( P < 5 \) kbar (probably \( \leq 3 \) kbar), with an upper temperature limit of 700°C. The pressure range may be the dominant parameter for the formation of both ferromagnesian and calcic TCS, as well as disordered pyriboles containing triple chains.

Key-words: non-classical pyriboles, triple-chain silicates, "clinochesterite", HRTEM, Mariana trench, Widgie-mooltha, western Australia, PT conditions.