



Non-classical accessory phosphate minerals in metapelitic rocks

C. Chopin (1), Th. Armbruster (2), A. Baronnet (3), F. Cámara and R. Oberti (4)

(1) Laboratoire de Géologie, ENS-CNRS, Paris, France, (2) Laboratorium für chem. mineral. Kristallographie, Universität Bern, Switzerland, (3) CRMCN-CNRS, Campus de Luminy, Marseille, France, (4) C.N.R. - Istituto di Geoscienze e Georisorse, Pavia, Italy

(chopin@geologie.ens.fr)

Beside – or instead of – the classical accessory phosphates characterized by large-size cations, metamorphic rocks of sedimentary or hydrothermal derivation can bear phosphates of Mg, Fe and Mn which may contain in addition Al or larger-size cations. These are in particular wagnerite $(\text{Mg,Fe,Mn})_2\text{PO}_4(\text{F,OH})$, lazulite $(\text{Mg,Fe})\text{Al}_2(\text{PO}_4)_2(\text{OH})_2$, and arrojadite-group minerals, presently defined as $\text{KNa}_4\text{Ca}(\text{Fe,Mn,Mg})_{14}\text{Al}(\text{PO}_4)_{12}(\text{OH,F})_2$. The latter were long considered as restricted to granitic pegmatite but also occur in metaquartzite and in hydrothermal veins cross-cutting shale and iron-stone. Recent findings and our re-investigation of classical material reveal large compositional variations, which go so far beyond those suggested by the above formula that the mineral may act as a sink for Ba and Sr. These variations may, or may not, be related to pressures and temperatures of formation that cover a much broader range than anticipated. Together with new crystal-structure data, they imply complete reconsideration of the crystal-chemistry of the arrojadite group, which will be briefly outlined (but thoroughly addressed in the companion contribution by Oberti et al. [1]), including an assessment of the role of lithium, fluorine and OH groups in this complex structure.

Wagnerite and lazulite have received more attention from a petrological and experimental point of view, so that thermodynamic data are now available for lazulite and the Mg–OH end-member of wagnerite [2, 3, 4]. Application of these data to natural assemblages reveals the dramatic effect of fluorine in stabilizing wagnerite toward low pressures and accounts for the scarcity (absence?) of lazulite in HP and UHP rocks. In

addition to these phase relations and compositional variables that are of direct petrological relevance, wagnerite-group minerals also show an uncommon structural variable. Periodic faulting of the arrangement of the fluorine atoms creates a modulation of the structure along b , which results in a variety of polytypes (and space groups) with at least $2b$, $5b$, $7b$ and $9b$ superstructures [5, 6, 7]. The relative importance of P and T, chemistry and kinetics in the control of this structural parameter will be discussed.

Therefore, even if restricted to Ca-poor rocks, these often neglected accessory phosphates should rather be considered, through their structure and composition, as a valuable source of information supplementing the classical geochemical and petrological approach.

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