

THERMODYNAMIC EQUILIBRIUM OF THE SÃO JOÃO MARCOS IRON FORMATION UNDER GRANULITE FACIES METAMORPHISM AND HYDROTHERMAL MUSCOVITIZATION: PREVIOUS CONSIDERATIONS

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ABSTRACT: The recently called “São João Marcos” Iron Formation consists in an iron formation located between the districts of Rio Claro and Mangaratiba, Rio de Janeiro State, Brazil. This IF is part of the tectonic context of Ribeira and Brasília belts, and has been cited in some previous works under the nomenclature of “magnetite quartzite”, but it has not been submitted to detailed petrographic and petrologic studies so far. In field, the IF shows direct association with mafic rocks, outcropping under high alteration state by weathering or as blocks of fresh rock possibly near to their hidden source. Other associated lithologies include sillimanite quartzite, impure quartzite (containing few percentages of other minerals, such as feldspar, apatite, muscovite, biotite and tourmaline) and (sillimanite)-garnet-biotite gneiss, all concordant to the regional NE-SW trend, besides being folded together. Petrographic description of thin and polished sections has showed that magnetite is not the only opaque phase of the IF, but also hematite under the form of incipient martitization along the (111) planes, and ilmenite as exsolution lamellae and inclusions. Spinel (possibly hercynite) occurs as exsolution lamellae and borders around the magnetites. Other phases include almandine garnet associated with the bands of opaque minerals, minor feldspar porphyroclasts, biotite, rutile and muscovite, the latter two commonly bordering some of the magnetites. Locally, orthopyroxene and amphibole (cummingtonite-grunerite) occur around the magnetites. Data allowed the construction of a thermodynamic grid of this high grade metamorphic system, in which the reactions $2\text{Biotite} = \text{Almandine} + \text{Magnetite} + 3\text{Quartz} + 2\text{H}_2\text{O}$ (1), $2\text{Biotite} + 14\text{H}_2\text{O} = \text{Sillimanite} + 2\text{Magnetite} + 5\text{Quartz} + 32\text{H}^+$ (2), $\text{Magnetite} + 3\text{Spinel} + 8\text{Quartz} + 5\text{H}_2\text{O} = 2\text{Sillimanite} + 2\text{Biotite} + 6\text{H}^+$ (3), $\text{Almandine} + 3\text{H}_2\text{O} = \text{Magnetite} + \text{Sillimanite} + 3\text{Quartz} + 6\text{H}^+$ (4), $3\text{Almandine} + 2\text{H}_2\text{O} = 3\text{Spinel} + 2\text{Magnetite} + 9\text{Quartz} + 4\text{H}^+$ (5), $\text{Magnetite} + 3\text{Sillimanite} + 2\text{H}_2\text{O} = 3\text{Spinel} + 3\text{Quartz} + 4\text{H}^+$ (6), illustrate the equilibrium grid centered by sillimanite, resulting from biotite reaction furnishing elements for sillimanite and almandine production, and sillimanite to generate spinel, under significant desilication. Diagram and microscopic studies revealed and suggested the participation of magnetite as an important constituent. Hydrothermal activity likewise showed the sillimanite replacement by muscovite coexisting with biotite, almandine and spinel, reinforcing thermodynamic equilibrium in both situations. Petrogenetic grids of chemical potential system in terms of $\mu\text{H}_2\text{O}$ and μSiO_2 are used to illustrate the reactions significantly helped the study. Despite strong deformation the IF is conformable with the other metasedimentary lithologies, also suggesting its initial sedimentary origin. Furthermore, a possible hydrothermal influence in the genesis of this iron formation could be accepted if we consider the widely known models of precipitated iron, once all field evidences point to a possible Neoproterozoic Algoma Type iron formation deposited in rift basin with high amount of continental contaminants. However, this consideration can only be made (or refused) soon with additional data (i.e. geochemistry) that supports the idea of a hydrothermal iron source.

PALAVRAS-CHAVE: IRON; METAMORPHISM; THERMODYNAMICS