CHARACTERISATION OF SFCA PHASES IN IRON ORE SINTER BY COMBINED OPTICAL MICROSCOPY AND ELECTRON PROBE MICRO ANALYSIS (EPMA)

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ABSTRACT

Iron ore sinter mineralogy and its associated macro-/micro- structure has a strong impact on sinter quality. At a macroscopic scale, sinter ideally consists of a strong, porous matrix which bonds relict ore nuclei together. Microscopically, the sinter matrix (solidified from the melt part of the initial sinter mix) generally consists of complex calcium ferrites known as SFCA, secondary magnetite and haematite grains (precipitated from the primary sinter melt), glass and silicates. Depending on the conditions under which the sinter structure is formed, two major forms of SFCA with different morphologies are generally recognised, i.e. fine micro-platy SFCA (usually termed SFCA-I), and coarse columnar/prismatic SFCA. Detailed optical microscope observations of several pot grate and compact sinter samples revealed the presence of a variety of fine, coarse, and dense forms of both types of SFCA. The controlled cooling tests revealed that cooling rate has an impact on the form and size of SFCA crystals. In this work, EPMA analysis of SFCA compositions from a variety of pot grate and compact sinter samples are presented. Results show that the SFCA types exhibit a broad range of complex compositions within the system Fe_2O_3/CaO/SiO_2/Al_2O_3/MgO/TiO_2/MnO_2. Although SFCA-I and SFCA are known to be crystallographically distinct and with different, well defined ranges in composition, there was considerable overlap in compositions of the experimental sinter samples. The development of SFCA textures depend on several parameters including the local chemistry and conditions including the maximum temperature attained and the cooling rate, within the sinter bed, thereby suggesting that SFCA identification based on morphology alone may be erroneous.

Keywords: iron ore sinter, sinter matrix SFCA-I, SFCA, optical mineralogy, EPMA