3D characterisation of natural iron ores: imaging the invisible?

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ABSTRACT

In Australia, Iron Ore account for the vast majority of mineral volume (around 90%) exported and it represents about half of the total value in mineral export for the Australian economy. Almost 1 Billion tonnes of Iron Ores (A$60b) were produced in Australia in 2017 with approximately 96% of the iron ore exports mined from deposits located in the Hamersley province of Western Australia. The quality of an iron ore deposit is directly related to its Fe content and to its geometallurgical properties. Higher Fe content and better geometallurgical properties will attract a higher selling price. Ultimately, Fe content and geometallurgical properties are controlled by mineralogical, chemical and textural (3D distribution of pores and minerals and their shape/association characteristics) parameters. Optical and scanning electron-based microscopy techniques (SEM, MLA™ and QemSCAN™) are the most commonly used for iron-ores. Over the past decade, the advanced in high-resolution X-ray computed tomography (HRXCT) allowed the acquisition of three-dimensional (3D) datasets at submicron resolution that not only provide some striking 3D images but can also be processed and analysed to provide quantitative in situ mineralogical and textural measurements that are impossible to access accurately by any other method. In this contribution, we developed a workflow combined using HRXCT with more traditional techniques to provide new insights into the fine microstructure (in term of pore network topology and mineralogy) of Australian Iron Ore. The results have implication for ore quality and for the assessments of the mobility of deleterious elements such as Al, Si, P or S.