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Mineralogy of TiO_2-ilmenite heavy mineral sand deposit of Nataka

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The worldwide demand in raw materials for pigments, and the depletion of existing rutile deposits, have enhanced interest in ilmenite as a feedstock for TiO_2 production. Consequently, the characterization of ilmenite morphology, association and level of impurities is a prerequisite to determine potential routes of ore processing and product uses. Furthermore, the recent discovery of hydroxylian pseudorutile, in the Australian deposits has emphasised the need for a deeper understanding into ilmenite alteration.

The Nataka heavy mineral sand deposit occurs along the northeast Mozambique coastline (fig. 1). It comprises of a regional Pleistocene red elliptical structure extending from Kenya, passing through Tanzania, Madagascar and Mozambique, to Richards Bay in South Africa. The deposit formed under the influence of a tropical climate in two different palaeo-environments: dunes, with elevation ranging over 100 m above mean sea level, and wet lands, forming the borders.

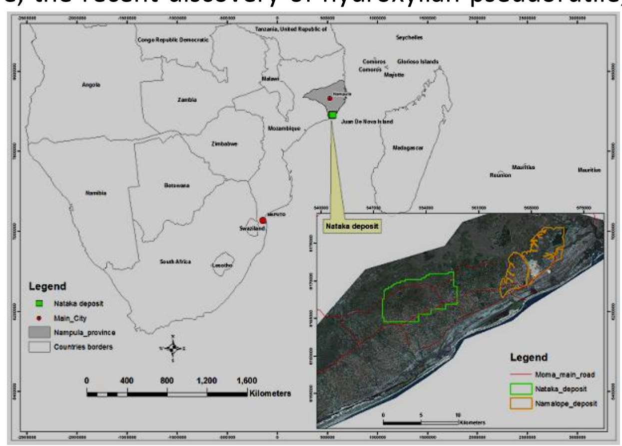

Figure 1: Nataka deposit location.

The deposit consists of fine- to medium- grained, weakly consolidated red sediments, hosting heavy minerals. The deposit mineral assemblage is made up of non-economic phases comprising mostly magnetite, hematite, chromite, monazite, and the economic phases dominated by ilmenite (51 wt. %), with additional zircon and rutile (10 and 4 wt. % respectively). The economic minerals comprise about 2 % volume of the deposit and the probable resources total about 445 Mt (million tonnes). This study focuses on the mineralogical characterization of ilmenite from the Nataka deposit, alongside some of the implications for ore processing.

Mineralogical and chemical characterisation of ilmenite undertaken on 32 samples from 16 selected drill holes using a combination of QEMSCAN and EPMA revealed that the ilmenite has undergone different stages of alteration, at distinct environment conditions, yielding products spanning from hydrated ilmenite to leucoxene. The alteration dominantly involved groundwater, which was oxidizing and acidic, hence the predominance of ilmenite-pseudorutile alteration. Long exposure to direct sunshine has been hypothesized as a different process that might have favoured the direct alteration of ilmenite to leucoxene and of pseudorutile to leucoxene, on a smaller scale. The major impurities in the ilmenite are

Al and Si, which are enriched in the advanced ilmenite alteration products (leucoxene), where they fill pores and cracks. Chromium impurities occur as discrete grains of chrome spinel.

A correct selection of ilmenite-feedstock processing route (chloride or sulphate) for TiO_2 slag production is intimately dependent on the genesis of Cr impurities and Ti concentrations levels, which can be exhaustively revealed by this approach. Relative low occurrence of high Ti phases and discrete Cr impurities qualify ilmenite of the Nataka deposit for the chloride route. In addition, heavy mineral associations study is invaluable for plant optimization during mineral processing, as it enlighten on the magnetic susceptibility, one of the core features in heavy minerals separation.