**ABSTRACT**

The research area, which occurs within the Neoproterozoic Mozambique belt (NMB) in Kenya, is located in Mutomo-Ikutha area, in South Kitui district, Kitui County. The study area is bounded by longitudes 38° 04ÍEj to 38°20ÍEj and latitudes 1°48ÍSj to 2°10ÍSj The area can be accessed from the Nairobi-Thika-Kitui/ Nairobi-Machakos-Kitui roads, or from Nairobi ï Mombasa Road ï Kibwezi ï Ikutha-Mutomo road. An enigmatic problem within the polyphase and highly deformed NMB is lack of better understanding of the geology, tectonic structures and metamorphism that affected the formation, occurrence and genesis of the iron ore deposits and other related minerals in the study area. In order to decipher the aforementioned problem, this study undertook a geological, geochemical and geophysical study with the aim of having a better understanding of the petrology, tectono-metamorphic setting, genesis and distribution of iron ore deposits and related mineralization in the study area.

Ground magnetic and geochemical surveys were carried out to establish the spatial distribution and potential reserves of iron deposits in the study area. Investigation using remote sensed data has established prevalent geological structures, lithology and mineral alteration zones. This study has provided a comprehensive understanding of the tectono-thermal scenario and its associated economic mineralization. One of the key findings of this study is the realization that Mutomoï Ikutha gneisses and migmatites represent a thick sequence of meta-sedimentary rocks. The entire protolith sequence was marked by the alternation of thin pelitic, psammitic and limey layers, together with minor thin basic meta-volcanic rocks that were deposited under deep marine conditions. The entire paragneissic sequence was subsequently subjected to multiple phases of successive deformation and metamorphism, which was accompanied by shearing, faulting and folding. Three phases of folding ($F_1$, $F_2$ and $F_3$) were accompanied by medium- to high-grade amphibolite-facies metamorphic conditions. The mean attitude of $F_1$ hinges plunges between $10^0$ and $25^0$ to N320$^0$W, $F_2$ plunges between $12^0$ and $70^0$ to S140$^0$E, and $F_3$ plunges $15^0$ and $25^0$ to 270$^0$W. From these data, it is apparent that the $F_1$ and $F_2$ had dominantly NWï SE striking axial surfaces, with gently plunging hinges, whereas the superimposed $F_3$ folds generally have W-E orientations. The geometrical relationships between $D_1$ and $D_2$ structures suggest that the Mutomo ï Ikutha structures were mainly developed in response to a NEï SW compressional stress regime. The deformation sequence ($D_1$, $D_2$ and $D_3$) clearly indicate that the iron mineralization in Mutomoï Ikutha was controlled by tectonics and high-grade metamorphism. Shearing of the hornblende gneiss host rocks took place during the $D_3$ episode where the main reef of iron deposition took place during $D_3$ deformation phase. The iron ore deposit is structurally controlled by shear zone and is hosted in the hornblende gneiss. Shearing along the western part of the area, especially within Tiva gneisses created room for iron ore deposition.

Metamorphism affected iron formation in two ways. Two sets of metamorphism ($M_1$ and $M_2$) took place in Mutomo ï Ikutha area. Iron mineralization took place during $M_1$ as evidenced by the replacement of hornblende by iron. $M_1$ resulted from the collision of East and West Gondwanaland that was accompanied by magmatism and hydrothermal processes. Iron ore formed during $M_1$ episode from late stage magmatism and hydrothermal process. Two sets of metasomatism took place in the area. The first metasomatism led to the formation of calc ï silicates while the second set of metasomatism led to the formation of iron in pegmatites. Petrographic evidence have shown the occurrence of the iron ore deposit in Mutomo ï Ikutha vi

area to be associated with the rocks whose mineral assemblage is of Hornblende + Quartz + Biotite + Magnetite + Apatite ± Plagioclase. Petrological studies have shown that Mutomoï Ikutha area occurs in an ophiolitic suite and mimics similar lithological and geochemical signatures as those reported in other ophiolite suites occurring in Kenya like in Moyale, Sekerr in West Pokot and in Voi, SE Kenya. The field occurrence of this suite has been documented by the lithological and stratigraphic sequence of serpentinite, sheeted dykes, gabbro, limestone and remnants of pillow lava found in the type area. The field occurrence of this suite is an indication of the remnants of the obducted oceanic crust during the closure of the palaeo- Mozambique Ocean and collision of the East and West Gondwanaland.

Geochemical evidence indicate that the iron ore deposit of Mutomo ï Ikutha area contain between 48 ï 93 % $Fe_2O_3$, 0.2-5.9% $P_2O_5$, 0.05 ï 1.9 % $TiO_2$ and 0.007% - 1.3% V. The characteristic chemical signatures of Ikutha deposits closely resemble the Apatite ï Iron ores of the Kiruna type. The $Fe_2O_3$ has positive Pearson correlation of 0.59 with $P_2O_5$ and shows negative correlation with other elements found within the host rock. This shows that the mode of delivery of the two elements into the area were similar. $Fe_2O_3$ and $P_2O_5$ are interpreted to have been introduced into the area through hydrothermal/ magmatic fluids.

The iron ore deposits in Ikutha area cover an area of 5 sq km with a reserve tonnage of 250 million tons of magnetite. Besides the occurrence of iron ore deposits in the study area, this study has also established the presence of other minerals of economic importance like manganese, garnets, copper, magnesite, graphite and marbles. It is envisaged that mining and subsequent beneficiation of these minerals will bring a great economic growth in Kitui County and the country as a whole. This study recommends that drilling works should be done to establish the actual tonnage and quality of the iron deposits.