UNIVERSITY OF NAIROBI

PETROLOGY AND IRON ORE MINERALIZATION IN THE NEOPROTEROZOIC MOZAMBIQUE BELT ROCKS OF MUTOMO – IKUTHA AREA, KITUI COUNTY, S.E. KENYA.

BY

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NOVEMBER 2015

Declaration

I declare that this thesis is my original work and has not been submitted elsewhere for examination, award of degree or publication. Where other people's work or my own work has been used, this has been properly acknowledged and referenced in accordance with the University of Nairobi's requirements.

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Appendix I Declaration Form for Students

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Course Name: Ph.D. in Geology

Title of the work: PETROLOGY AND IRON ORE MINERALIZATION IN THE NEOPROTEROZOIC MOZAMBIQUE BELT ROCKS OF MUTOMO – IKUTHA AREA, KITUI COUNTY, S.E. KENYA.

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1. I understand what Plagiarism is and I am aware of the University's policy in this regard

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Date _____

Dedication

Dedicated to my beloved Father Willington Kutukhulu and My Mother Rebecca Kutukhulu

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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° 04′E to 38°20′E and latitudes 1°48′S to 2°10′S. The area can be accessed from the Nairobi-Thika-Kitui/ Nairobi-Machakos-Kitui roads, or from Nairobi – Mombasa Road –Kibwezi – 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 Mutomo–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 NW–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 – Ikutha structures were mainly developed in response to a NE–SW compressional stress regime. The deformation sequence (D_1, D_2 and D_3) clearly indicate that the iron mineralization in Mutomo–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 – 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 – 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 – Ikutha