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Early Kibaran rift-related mafic–ultramafic magmatism in western Tanzania and Burundi: Petrogenesis and ore potential of the Kapalagulu and Musongati layered intrusions

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Abstract

The Kapalagulu and Musongati intrusions are differentiated mafic–ultramafic intrusions, more than 1 km in stratigraphic thickness and several 10 s of km^2 in size. They form part of the Kabanga–Musongati belt of intrusions in western Tanzania and Burundi. The intrusions of the Kabanga–Musongati belt were emplaced at ca 1.4 Ga into pelitic sediments of the Burundi and Karagwe–Ankolean Supergroups that accumulated during an early rifting phase of the Kibaran orogeny. The parental magmas to the intrusions were of picritic composition (ca 15% MgO) that assimilated variable amounts of sulfidic sedimentary rocks during emplacement. Modeling suggests that the Musongati magma assimilated ca. 5% of sedimentary material, whereas the Kapalagulu magma assimilated ca. 15% of sediment. Contamination caused enrichment of the magma and the cumulates in incompatible trace elements, the development of negative Nb–Ta–Ti anomalies, and crustal sulfur isotopic signatures (δ^{34}S = +4.5 to +20). At Kapalagulu, contamination of the parent magma led to the formation of basal olivine melanorite cumulates. In the less contaminated Musongati intrusion dunites and harzburgites formed at the base. Both intrusions are prospective for magmatic Ni and PGE deposits. This is indicated by empirical observations, notably the presence of important Ni sulfide ores at Kabanga and reef-type PGE concentrations at Musongati and Kapalagulu. It is also supported by theoretical considerations, namely the high-magnesian composition of the parental magmas and the abundance of sulfides in the host sedimentary rocks. Weathering of the ultramafic rocks resulted in a thick lateritic crust that contains up to >4 ppm PGE and, at Musongati, hosts one the world's largest Ni-laterite deposits.

Keywords: Kapalagulu; Musongati; Tanzania; Burundi; Layered intrusions; Platinum-group elements

1. Introduction

The Kapalagulu and Musongati intrusions are layered ultramafic–mafic intrusions that are characterized by prominent olivine-rich melanocratic zones near the base of the bodies overlain by progressively more differentiated rocks with height. The intrusions show well-developed cryptic and modal layering with several compositional reversals. Both intrusions occur within, or at the periphery of, the Kibaran foldbelt and form part of a suite of mafic–ultramafic bodies that extends for some 500 km from Lake Tanganyika in the south

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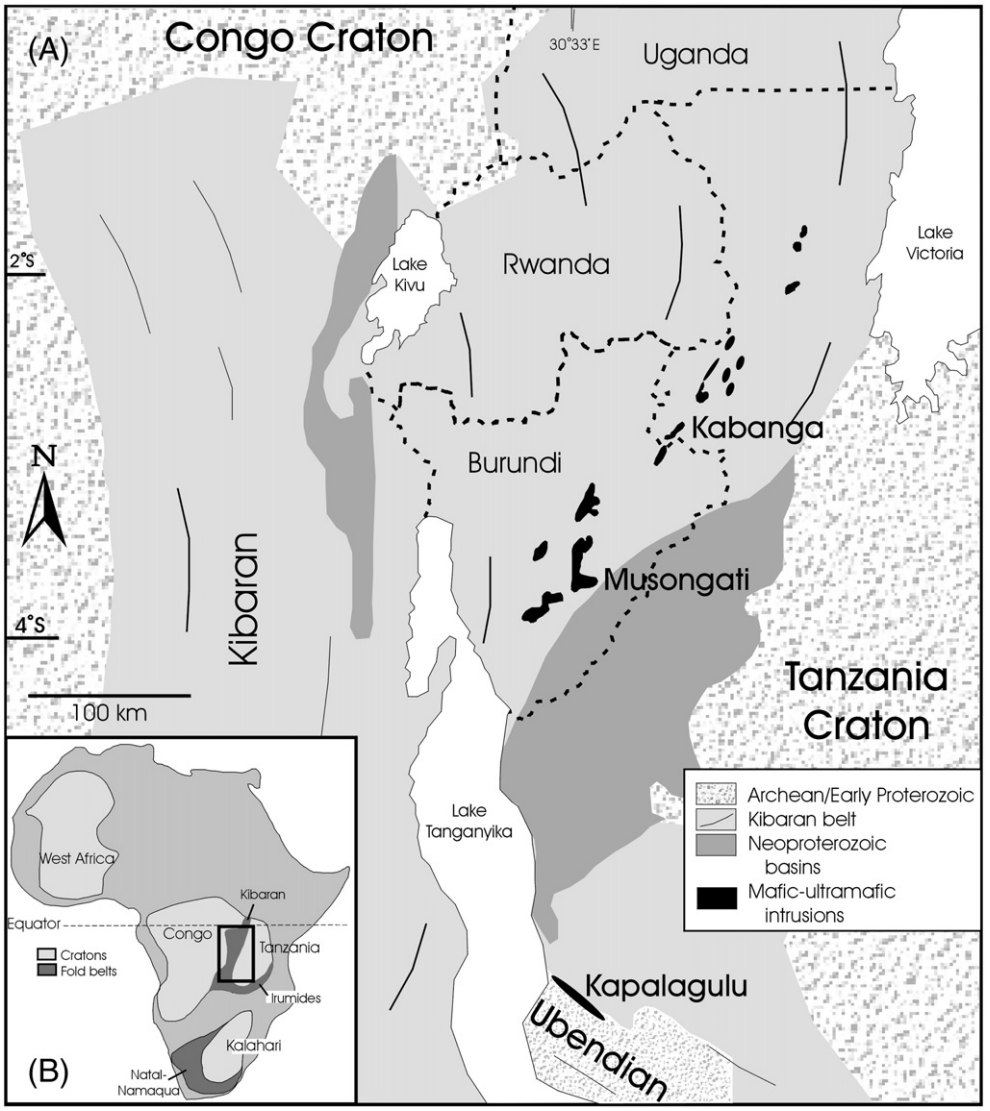

Fig. 1. Locality of the Kabanga–Musongati intrusions within the Kibaran belt of Burundi and Tanzania. Note the gap in the belt between Kapalagulu and the Burundian intrusions that is possibly due to lack of exposure beneath Lake Tanganyika. Insert shows regional context.

through Burundi into NW Tanzania (Fig. 1). Some of the intrusions host important ore deposits, notably magmatic Ni sulfides at Kabanga (Evans et al., 1999, 2000) and Ni laterites at Musongati and Kapalagulu (Bandyayera, 1997, Goldstreammining.com). There also appears to be potential for reef-type platinum-group element (PGE) mineralization (Deblond, 1994; Goldstreammining.com). Despite their potential economic significance many aspects of the composition and petrogenesis of these intrusions remain unknown. Three questions may be highlighted: (i) Are there any compositional similarities between the intrusions? (ii) Can we determine the nature of the parental magmas to the intrusions and thus estimate the composition of any sulphide ores that might be associated with the intrusions. (iii) In what tectonic setting did the magmatism occur and how does this compare to the setting of Ni and PGE deposits elsewhere? The present paper attempts to address these questions to provide improved guidelines for Ni and PGE exploration, in the Kibaran belt and elsewhere in the world.

2. Regional geology

2.1. General

The Kapalagulu and Musongati intrusions form part of a group of mafic–ultramafic intrusions that has been