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Hydrothermal mica deposits in altered meta-ultrabasites from north-central Sri Lanka

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ABSTRACT

Extensive vein-type mica deposits at Elahera in north-central Sri Lanka are associated with meta-ultrabasite (MUB) boudins in impure marbles. Mineralization occurs as discontinuous, lenticular bodies concordant with the impure marbles at the contacts with MUB. Impure marbles show typical granulite facies assemblages overprinted by retrograde minerals. The original assemblages of MUBs have been texturally and mineralogically replaced completely, but the alteration did not progress into impure marble country rocks. The alteration products are mainly phlogopite with minor tremolite, calcite and quartz. The micas have likely been formed as a result of the breakdown of diopside in the MUBs. Rock textures and chemical data of whole rocks and minerals suggest that the alteration is due to infiltration of external hydrothermal fluid through the contacts of MUB boudinage layer and impure marbles. The calcium, magnesium and CO_2 required for formation of alteration minerals may have been acquired from the host rock, whereas silica, K, Cl and Al were externally derived and transported with the fluid. The most likely source of hydrothermal fluid is exsolved fluid from nearby granitic pegmatites, based on field relations showing preferred contents of mica near pegmatite contacts.

1. Introduction

Economic concentrations of trioctahedral mica are distributed in many parts of the world (Martin et al., 2014; Nawaratne, 2009; Yang et al., 2011), including Sri Lanka, as described in this paper. Their chemical composition, nature of mineralization, host rocks and genesis vary widely in the different localities (Belkin et al., 1988; Ivanov and Grozdanov, 2001; Rizzo et al., 2001; Yavus et al., 2002). Economic mica deposits are commonly associated with low-grade metamorphic rocks and pegmatites (Babu, 1969; Brock, 1974; Fernando et al., 2011; Wise and Brown, 2010). However, such economic concentrations of mica in association with hydrothermal deposits like those studied here are less common.

Hydrothermal fluids may be magmatic, meteoric or metamorphic in origin (Hanson, 1992; Hedenquist and Lowenstern, 1994; Heinrich et al., 2004; Wilkinson, 2001). Of these, magmatically-derived fluids more commonly yield metallic ore deposits (Hedenquist and Lowenstern, 1994; Marchev et al., 2005; Sillitoe and Hedenquist, 2003). Further, some economic deposits of silicate minerals have formed from residual fluids originated from magmatic processes (Heinrich and Levinson, 1961; London and Burt, 1982; Shigley and Brown, 1985). In detail, the hydrothermal alteration phenomenon is very complex but in general, it can be categorized as argillic, phyllic, propylitic or potassic (Pirajno, 2010). The potassic alteration is commonly responsible for producing mica. Among the mica group minerals, biotite and phlogopite are commonly found in hydrothermally-altered rocks (Bol et al., 1989; Grapes, 1993; Tracy, 1991; Mansker et al., 1979; Shabani et al., 2003; Shaw and Penczak, 1996; Solie and Su, 1987). In contrast to the many studies on mica deposits associated with pegmatites (Barton, 1987; Černý and Ercit, 2005; Černý, 1989, 1991; Fernando et al., 2011), investigations on hydrothermally-derived mica deposits are scarce.

Significant mica mineralization occurs at Elahera in north-central Sri Lanka (Fig. 1). These deposits are associated with impure marbles of the Highland Complex (HC) and many of them were mined few decades ago using conventional open-pit excavation methods. However, most of them are currently inactive as they occur in a thick tropical forest where the government has banned mining. At present, mica mining is being carried out only in the outside of the banned area by the local people. Since mining activities are limited to conventional methods, miners can extract only the mica deposits closer to the surface. Prior to the exporting, the preliminary manual processes are being carried out, however, chemical and mineralogical characteristics of mica are poorly known.

The origin of these deposits is not clear, especially regarding the source of hydrothermal fluids and the potential role of pegmatite intrusions in the area. This study involves field and petrographic

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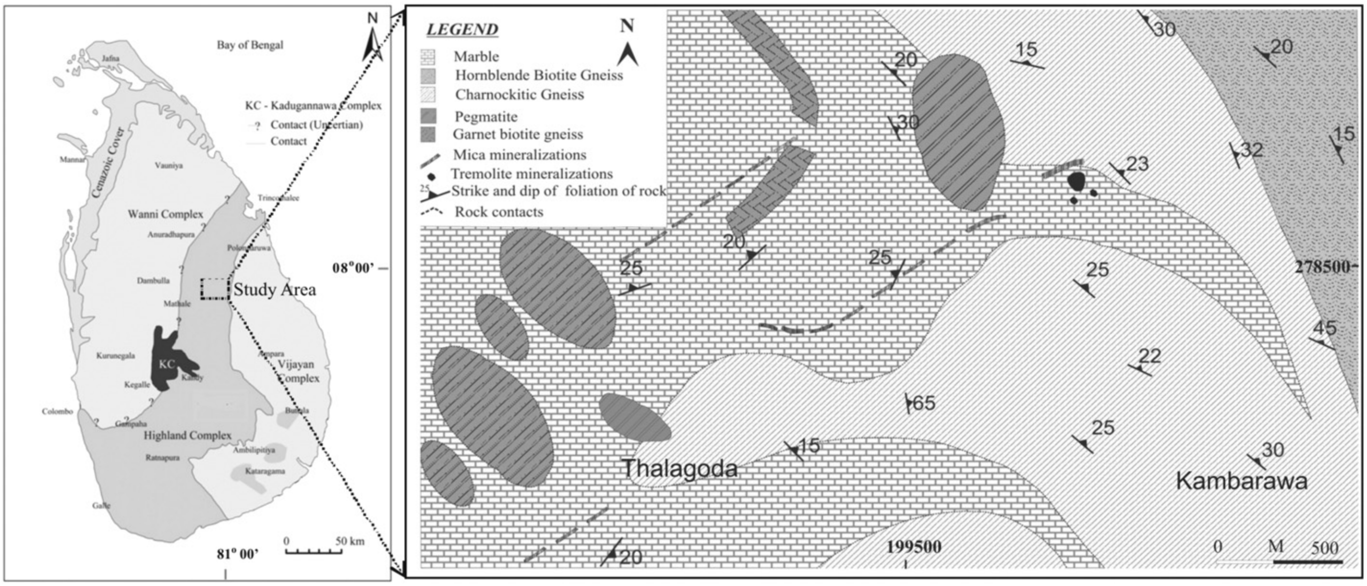

Fig. 1. Geotectonic subdivisions of Sri Lankan high grade crust (left) (after Cooray, 1994) and geological sketch map of the study area showing the occurrences of mica and tremolite mineralization within the HC around Elahera, central Sri Lanka (right).

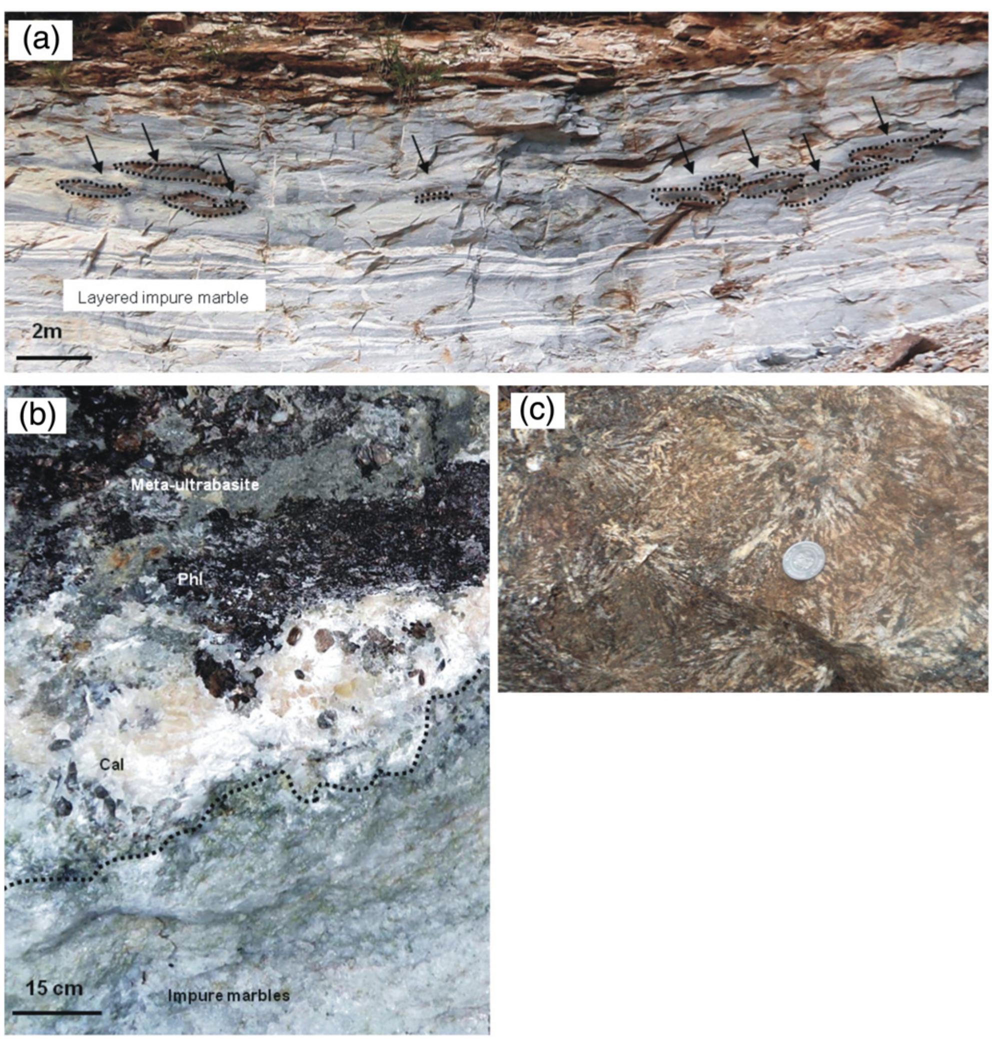

Fig. 2. Outcrop photographs showing the occurrence of mica and other alteration minerals in marbles and calc silicate rocks at Elahera; (a) structurally concordant, slightly altered ultrabasic boudins (black arrows) in layered impure marbles; (b) phlogopite (Phl) and calcite (Cal) at the contact between MUB boudins and impure marble (black dotted line marks the contact between the altered zone and host marble) and (c) clusters of coarse grained actinolite and tremolite.