JOURNAL GEOLOGICAL SOCIETY OF INDIA
Vol.93, February 2019, pp.171-176

Uranium and Thorium Anomalies in the ~2.5 Ga Vendodu Leucogranite, Nellore Schist Belt, SE India and its Potential to Generate Uranium Deposits

Gaurav J. Kokandakar, Sachin S. Ghodke, Laxman B. More, B. Nagaraju, Munjaji V. Bhosle, S.S. Sawant[#], K. Rathna and K. Vijaya Kumar*

School of Earth Sciences, SRTM University, Nanded – 431 606, India
#Geochemistry Division, CSIR-NGRI, Uppal Road, Habsiguda, Hyderabad – 500 007, India
***E-mail:** vijay_kumar92@hotmail.com*

ABSTRACT

The Vendodu intrusive, emplaced at 2483±3 Ma within the Nellore schist belt, SE India, is a K-rich per-aluminous A-type leucogranite composed of quartz and alkali feldspar (essential minerals), biotite, zircon, allanite, titanite, magnetite and apatite (magmatic accessory minerals) and muscovite, haematite, fluorite and uraninite (hydrothermal accessory minerals); zircon and uraninite could be both magmatic and hydrothermal. The Vendodu leucogranite is characterized by high Rb, Zr, Nb, Th, U and REE, low Ca, Al, Ba and Sr abundances, and large negative Eu anomalies. U content in the Vendodu leucogranite averages 17.63 ppm and is 6 to 11 times higher than average concentration of U in Upper Continental Crust (UCC) and Archaean granitoids. Similarly, Th content averages 61.38 ppm and is 3 to 20 times higher than average concentration of Th in Archaean granitoids and UCC. The U distribution in the Vendodu leucogranite is influenced by both magmatic and high-temperature hydrothermal processes. Processes that have enriched U have also increased LREE, Nb and Cr contents in the leucogranites. Geochemical proxies including Th/U, Zr/U and V/Yb suggest both magmatic and high-T hydrothermal (deuteric) enrichment of U over a wide range of temperatures and oxygen fugacities. High Th/U ratios in the Vendodu leucogranite (1.62–9.76) hint that the hydrothermal (deuteric) fluids were possibly magmatic. Petrographic and geochemical evidences suggest that the Vendodu leucogranite experienced magmatic and deuteric U enrichment that has potential to form mineralized zones either *in situ* or in pegmatitic veins.

INTRODUCTION

Archaean granitoids record evolution of the early continental crust and its ore deposits. Sites, rates and processes of crust formation significantly changed at the Archaean-Proterozoic boundary: the Na-rich granites of the early Archaean are largely succeeded by late Archaean K-rich granites (Kemp and Hawkesworth, 2003), which make up 20% of presently exposed Archaean cratons (Condie, 1993). The K-rich leucogranites contain high proportions of radioactive elements and are considered to have increased the upper crustal budget of K, Rb, Cs, U, Th, LREE, Zr, and Hf, and possibly form the sources for Palaeoproterozoic uraniferous conglomerates as well as unconformity-related U deposits in the Palaeoproterozoic intra-cratonic basins (Taylor, 1987; Cuney, 2014).

Uranium ores are characterized by a spectrum of compositions resulting from different geologic origins (Cuney, 2009). Spatio-temporally, the U-deposits range from Archaean-Proterozoic boundary to Recent and deep-seated magmatic cumulates to surface regoliths (Sarangi and Krishnamurthy, 2008; Cuney, 2009). The International Atomic Energy Agency (IAEA) proposed 15 distinct types of U deposits (Hore-Lacy, 2016). Granite-hosted uranium mineralization is one of the important U-deposits (magmatic and hydrothermal vein-type) (Cuney, 2009). Leucogranite hosted U deposits, in general, are low grade (<0.1 wt.% U) but large tonnage (>100 Mt) (Cuney, 2014). Four types of U deposits associated with leucogranites include: (1) primary disseminations and segregations, (2) primary mineralization in aplites and pegmatites (late differentiates; syngenetic), (3) high-T hydrothermal deposition in veins and fractures (epigenetic) and (4) low-T hydrothermal deposits due to meteoric water interaction (Cuney, 2009 and 2014).

In the present study, positive uranium anomalies in circa 2.5 Ga Vendodu leucogranite from the Nellore schist belt, SE India and highlight its potential to host U-deposits is reported.

GEOLOGY AND PETROGRAPHY

The curvilinear Nellore Schist Belt (NSB) is the easternmost greenstone belt within the eastern Dharwar craton (Fig. 1A) and is sandwiched between the granulitic rocks of the Eastern Ghats belt (EGB) to the east and the intracratonic Cuddapah basin and TTG gneisses to the west (Fig. 1B). The NNE-trending NSB is up to ~600 km long and 30 to 130 km wide, and is composed of amphibolites, granite gneisses and metasediments, including banded iron formations (Vijaya Kumar et al. 2006). The present study area in the southernmost part of the NSB occurs between 2.7-2.6 Ga Archaean TTG to the west and the arc-related 1.8-1.7 Ga Eastern Ghats granite-migmatite complex to the east (Fig. 1C). Contacts between the different formations are either thrust or high-angle reverse faults (Fig. 1C). Hornblende- and biotite-granodiorite and leucogranite bodies are dispersed within the amphibolites and schistose rocks around the Kandra area (Fig. 1C). Leucogranites occur as domical stocks and elongate plutons within the schistose rocks. The strike directions of the host NSB terrane and the linear trails of leucogranite are conformable. A younger (1.85 Ga) ophiolite (Leelanandam, 1990; Sesha Sai, 2009; Vijaya Kumar et al., 2010; Saha, 2011), also occurs in the area, suggesting that the zone experienced repeated tectonothermal events. The leucogranites show intrusive relationships with the NSB, but thrusted and sheared contacts with the Kandra ophiolite complex (Fig. 1C).

The Vendodu leucogranite, member of the circa 2.5 Ga K-rich leucogranite magmatism (Vijaya Kumar et al., 2011), occurs as an isolated stock to the southwest of Kandra ophiolite complex within the Nellore schist belt (Fig. 1C). SHRIMP U-Pb dating of magmatic zircons indicate that the Vendodu leucogranite was formed at 2483±3

0016-7622/2019-93-2-171/$ 1.00 © GEOL. SOC. INDIA | DOI: 10.1007/s12594-019-1147-3