Fluid inclusion and EPR spectroscopic study of Ta–Nb mineralization in Kadavur, Tamil Nadu, India

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Kadavur is a significant Proterozoic anorthosite–gabbro complex, located within the Madurai block of the southern granulite terrain, India. In Kadavur complex, the marginal zone is made up of rapakivi granites and dolerite dykes and the core of this complex is made up of late-stage intruded pegmatites. Tantalum–niobium (Ta–Nb)-rich pegmatites ($n = 20$) and barren pegmatites ($n = 5$) were studied for fluid inclusion and electron paramagnetic resonance (EPR) characterization. Five and two distinct fluid inclusions are identified in the Ta–Nb-rich pegmatites, and barren pegmatites respectively. In the mineralized samples, carbonic inclusions show depression in the CO_2 melting temperature indicating the presence of volatile phases of N_2, C and CH_4, which is also confirmed by a laser Raman microprobe. The similar range of trapping temperatures and different modes of homogenization (liquid and vapour) are attributed to the fluid immiscibility process for Kadavur Ta–Nb mineralization. The EPR is one of the exploration tools for many mineral deposits. EPR spectra signals for mineralized pegmatite and barren pegmatite samples show the paramagnetic induced defect centres of E_1 and peroxyl types identified in Kadavur, India.

Keywords: Electron paramagnetic resonance spectroscopy, fluid inclusion, Kadavur, quartz, Ta–Nb rich pegmatite.

KADAVUR is a significant Proterozoic basin located within

amounts of mica, tourmaline and garnet. The complex pegmatites are formed by the mineralization of simple pegmatites attenuated by hydrothermal (late-stage) fluids that dissolved the older minerals and precipitated a new one (giving rise to commercial pegmatites). It has different patterns and is commonly associated with different mineral assemblages. The zoned pegmatites have three zones – wall zone, intermediate and quartz-rich core zone. The wall zone is composed of quartz, feldspar, mica, columbite-tantalite, fluoro-apatite, spodumene, tourmaline, beryl, epidote, magnetite and ilmenite. The intermediate zone comprises quartz, *k*-feldspar, biotite, tourmaline, columbite-tantalite and magnetite. The core zone is enriched with quartz and a minor amount of *k*-feldspar, biotite, tourmaline, fluoro-apatite and columbite-tantalite. Overall, pegmatites are composed of pink (*k*-feldspar), white feldspar (plagioclase) and quartz. Biotite and muscovite occur in minor amounts. The columbite–tantalite, fluor–apatite, tourmaline, beryl, zircon, allanite, magnetite occur as accessory minerals (Figure 2)[5,6]. At the time of Ta–Nb

