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The Tumbarumba Basaltic Gem Field, New South Wales: In Relation to Sapphire-Ruby Deposits of Eastern Australia

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ABSTRACT. Tumbarumba gemfield in the Snowy Mountains basalt province, NSW, yields corundums, zircons and garnet, corroded by magmatic effects and abraded by alluvial transport. Sub-basaltic contours suggest present drainage profiles mimic Miocene sub-basaltic leads. Six types of corundum were identified. Blue, green, yellow (BGY) zoned sapphires (80%) contain ferrocolumbite as a main mineral inclusion and exhibit variable Fe_2O_3/TiO_2 and low Cr_2O_3/Ga_2O_3 (<1). Two sub-types differ in colour absorption spectra, one being unusual in lacking the typical Fe^{2+}-Fe^{3+} charge transfer effects found in such sapphires. Related trapiche-like corundums (5%) show higher Cr_2O_3/Ga_2O_3, possibly due to Fe-Ti oxide exsolution. Vari-coloured, diffuse-zoned and pale blue sapphires (10%) have higher Cr_2O_3/Ga_2O_3 and colour absorption characteristics intermediate between BGY sapphires and pink to red corundums with elevated Cr_2O_3/Ga_2O_3. The BGY and trapiche-like sapphires are considered magmatic, the intermediate sapphires magmatic-metasomatic (possibly through interactions with Cr-bearing serpentinite bodies) and the pink to red corundums metamorphic in origin. Zircons include low- to high-U types. The latter show {100}-{110} prism combinations (unusual in eastern Australian zircons) and suggest incompatible element enriched parental melts. The magmatic sapphires and zircons (U-Pb age 23 Ma) crystallised in deep evolved salic melts, before transport in basalt. Magmatic-metasomatic sapphires contain zircon inclusions with both older inherited U-Pb ages (up to 903 Ma) and younger magmatic U-Pb ages (27–22 Ma). Basalts represent little evolved undersaturated melts (basanites and alkali basalts), and minor near-saturated transitional melts (olivine basalts). Most generated from garnet peridotite sources, but some from spinel peridotite sources. Mantle normalised incompatible multi-element patterns suggest Oceanic Island Basalt (OIB) melts interacted with amphibole (+ apatite) veined mantle. A sapphire and zircon-bearing basalt, also carries kaersutitic amphibole, apatite, alkali feldspar, titanian mica and titanian magnetite xenocrysts from a veined metasomatised source. Olivine micro-dolerite in a plug resembles the Cainozoic basalts in freshness, but its distinct trace element pattern and Early Devonian K-Ar age (400 Ma) indicate an earlier unmetasomatised spinel peridotite source. The Tumbarumba field evolved through explosive gem-bearing basaltic activity between 27–15 Ma and peaked in basalt lava activity. Interactions of basaltic melts with amphibole-rich mantle, serpentinite bodies and metamorphic corundum deposits combined to generate multi-modal gem suites.

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