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High Pressure Minerals and the Origin of the Tertiary Breccia Pipe, Ballogie Gem Mine, near Proston, Queensland

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ABSTRACT. High pressure minerals found in Miocene basaltic volcanics at Ballogie include large garnets, aluminous clinopyroxenes and orthopyroxenes, olivine, kaersutitic amphibole, anorthoclase and opaque oxides; they occur together with minor amounts of biotite, corundum and zircon. The garnet, some pyroxenes and anorthoclase can be of gem quality. The minerals accompany abundant lherzolite xenoliths in the volcanics and resemble some other occurrences in SE Queensland.

A magnetic survey of the site suggests a diatreme composed largely of breccia intruded by small basaltic bodies. The garnet (Mg_{62-66} Fe_{21-24} Ca_{12-14}), clinopyroxenes (Mg_{49-56} Ca_{34-39} Fe_{10-13}, with 6.7–8.5% Al_2O_3) and orthopyroxenes (Mg_{81-84} Fe_{12-15} Ca_{3-4}, with 4.8–5.8% Al_2O_3) probably represent xenocrysts derived from garnet pyroxenites and pegmatitic garnetites interlayered with spinel lherzolite mantle. The compositions suggest that these minerals crystallized under pressure-temperature conditions around 14–15 kb and 1000–1100°C. The Ti content of the kaersutites, using a new geobarometer, gives approximate pressures of crystallization mostly between 12 kb and 14 kb.

The bulk of the Ballogie minerals were sampled from a volatile-bearing upper mantle, relatively rich in Ti, but poor in Cr. The model invoked for the emplacement of a composite diatreme such as the Ballogie pipe involves sudden outgassing above a rising diapir by crack propagation. The resultant updrag also provides the potential to transport very deep material from the diamond stability zone.

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In 1981 Mr E.A. Thomson of Boondooma, Queensland asked the Department of Mineralogy and Petrology at the Australian Museum to investigate his gemstone lease at Coverty Creek, 17 km SSW of Proston (151°31.5′ E, 26°18.0′ S). The Ballogie Gem Mine, on the east side of the creek, yields gem-quality red garnet, comparable with the Garnet Gully prospect 10 km west at Brigooda (Queensland Geological Survey, 1981). The fragments come from a small alkali basalt exposure within granite country rock. (Fig. 1.) An anorthoclase megacryst from the basalt gave a K-Ar age of 16.0 ± 0.2 Myr, interpreted as the age of eruption (Sutherland & Wellman, in prep.). Other prominent minerals brought up by the basalt include olivine, pyroxenes and oxides, typical of high pressure megacryst suites found in eastern Australia (Wass & Irving, 1976).

The Ballogie basalt is not mapped, but lies amongst the northern Main Range Volcanics of south-eastern Queensland (Murphy *et al.*, 1976). It belongs to a younger episode than the bulk of these basalts and is not lateritized.

The site has potential for gem production and possible diamond exploration (Queensland Geological Survey, 1981) and was visited by the Museum in November 1981 and May 1982. Extensive collections were made of the volcanic inclusions by Hollis and Sutherland and a magnetometer survey was made over the basaltic body by Pogson. This paper deals with the form of the basalt and the mineral inclusions. A more detailed study of the Ballogie basalt will be given in a wider petrogenetic study involving the other basalt bodies and their inclusions from the Brigooda region, under study by the Australian Museum in association with A.D. Robertson, Geological Survey of Queensland. The geophysical survey carried out by the Museum in May 1982 was the first in the institution's history.