

Balmoral Beach Aboriginal Shell Midden, Port Jackson, Australia: Pumice Petrology and Sources

F.L. SUTHERLAND & B.J. BARRON

Geodiversity Research Centre, Australian Museum, 6 College Street, Sydney NSW 2000, Australia
lins@amsg.austmus.gov.au

ABSTRACT. Palaeopumice strand deposits (1800 to 4000 years B.P.) occur in the Balmoral Beach Aboriginal Shell Midden excavations. In composition, the pumice clasts are low-potassium dacites and contain up to 5% xenocrysts, phenocrysts and glomerophenocrysts of orthopyroxene, pyroxene, plagioclase and iron oxide minerals. The matrix includes smaller grains of these minerals in an abundant, highly vesicular rhyodacite volcanic glass. The 3300 year old and younger pumices typically contain rare xenocrysts and phenocrysts of magnesian olivine, forming an unusual mineral assemblage. One older pumice clast is a quartz-bearing rhyodacite, with distinctive trace element geochemistry. The typical dacites, resemble those erupted from the Tonga-Kermadec island arc in the Southwest Pacific, due both to the presence of olivine and the variably depleted trace and rare earth element contents. This implies a 4000 km drift caused by the East Australian oceanic current, before the pumice was stranded in Port Jackson.

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Pumice regularly washes up on Australian coasts, usually after storm activity. In an early observation, Clarke (1842) remarked “An investigation of the range of this drift pumice along the shores of Australia and Tasmania would not be an unimportant employment”. Since then, a few studies identifying pumice sources have been made. One major pumice stranding in southern Australian coasts and sub Antarctic islands, starting in late 1963, was traced to a 1962 submarine eruption in the South Sandwich Islands over 8000 km away (Sutherland, 1965; Coombs & Landis, 1966). This pumice dispersed on the southern polar currents may have even circumnavigated the Southern Ocean to restrand as fine pumice gravel on Australasian coasts by mid-1965 (Sutherland & Olsen, 1968). More recently, studies of pumice stranded on cays and beaches along North

Queensland have suggested Southwest Pacific sources, mostly from the Tonga-Kermadec island arcs some 4000 km away (Bryan, 1968; Stanton, 1992). This pumice travels on the South Equatorial Current, east to west from Fiji to the Coral Sea. Here the current splits and the main branch runs north to south along the Australian shelf deflecting off southern New South Wales to run from west to east (Rotschi & Le Masson, 1967; Tomczak & Hao, 1989; Burrage, 1993). Thus, Southwest Pacific sources could be expected to supply a large proportion of the pumice washing up on New South Wales coasts (Fig. 1). Extended sources could be involved as the tropical convergence separating the east to west flowing South Equatorial Current from the returning west to east currents ranges from 18–25°S (cf. Martinez, 1994, and Nelson *et al.*, 1994).