2. THERMOCHRONOLOGIC CONSTRAINTS FOR THE TECTONIC EVOLUTION OF THE MORESBY SEAMOUNT, WOODLARK BASIN, PAPUA NEW GUINEA

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ABSTRACT

During Ocean Drilling Program (ODP) Leg 180, 11 sites were drilled in the vicinity of the MoreSBy Seamount to study processes associated with the transition from continental rifting to seafloor spreading in the Woodlark Basin. This paper presents thermochronologic (40Ar/39Ar, 238U/206Pb, and fission track) results from igneous rocks recovered during ODP Leg 180 that help constrain the latest Cretaceous to present-day tectonic development of the Woodlark Basin.

Igneous rocks recovered (primarily from Sites 1109, 1114, 1117, and 1118) consist of predominantly diabase and metadiabase, with minor basalt and gabbro. Zircon ion microprobe analyses gave a 238U/206Pb age of 66.4 ± 1.5 Ma, interpreted to date crystallization of the diabase. 40Ar/39Ar plagioclase apparent ages vary considerably according to the degree to which the diabase was altered subsequent to crystallization. The least altered sample (from Site 1109) yielded a plagioclase isochron age of 58.9 ± 5.8 Ma, interpreted to represent cooling following intrusion. The most altered sample (from Site 1117) yielded an isochron age of 31.0 ± 0.9 Ma, interpreted to represent a maximum age for the timing of subsequent hydrothermal alteration. The diabase has not been thermally affected by Miocene–Pliocene rift-related events, supporting our inference that these rocks have remained at shallow and cool levels in the crust (i.e., upper plate) since they were partially reset as a result of middle Oligocene hydrothermal alteration. These results suggest that...
crustal extension in the vicinity of the Moresby Seamount, immediately west of the active seafloor spreading tip, is being accommodated by normal faulting within latest Cretaceous to early Paleocene oceanic crust.

Felsic clasts provide additional evidence for middle Miocene and Pliocene magmatic events in the region. Two rhyolitic clasts (from Sites 1110 and 1111) gave zircon $^{207}$(U)/$^{206}$Pb ages of 15.7 ± 0.4 Ma and provide evidence for Miocene volcanism in the region. $^{40}$Ar/$^{39}$Ar total fusion ages on single grains of K-feldspar from these clasts yielded younger apparent ages of 12.5 ± 0.2 and 14.4 ± 0.6 Ma due to variable sericitization of K-feldspar phenocrysts. $^{207}$L/$^{206}$Pb zircon, $^{40}$Ar/$^{39}$Ar K-feldspar and biotite total fusion, and apatite fission track analysis of a microgranite clast (from Site 1108) provide evidence for the existence of a rapidly cooled 3.0- to 1.8-Ma granitic protolith. The clast may have been transported longitudinally from the west (e.g., from the D’Entrecasteaux Islands). Alternatively, it may have been derived from a more proximal, but presently unknown, source in the vicinity of the Moresby Seamount.

INTRODUCTION

Active continental rifting, metamorphic core complex development, and seafloor spreading makes the western Woodlark Basin of Papua New Guinea an ideal area to study processes associated with the initial rupture of continental lithosphere (e.g., Hill et al., 1995; Taylor et al., 1999, and references therein). Ocean Drilling Program (ODP) Leg 180 was designed to examine processes associated with continental rifting, including low angle normal faulting, sedimentary basin evolution, and the movement of footwall blocks during the final stages of rifting and prior to seafloor spreading initiation (Taylor, Huchon, Klaus, et al, 1999).

One of the objectives of ODP Leg 180 was to determine the pressure-temperature-time (P-T-t) history of recovered igneous and metamorphic rocks to constrain the tectonic evolution of the Moresby Seamount, a bathymetric high bounded on its northern flank by a seismically active low-angle normal fault (Abers et al., 1997). The north-south transect drilled just west of the spreading tip recovered diabase, gabbro, basalt, and sedimentary rocks. We present results of a thermochronologic study of diabase and felsic igneous clasts recovered from sites drilled on the hanging wall and footwall of the normal fault bounding the Moresby Seamount. Results allow us to constrain, in part, the prerift tectonic evolution of the region and the geologic setting prior to the onset of crustal extension and seafloor spreading in the vicinity of the Moresby Seamount. Results are interpreted in the context of the present-day tectonic setting and the geologic evolution of the Papuan Peninsula.

PRESENT-DAY TECTONIC SETTING

The Woodlark Basin is located in the Solomon Sea southeast of Papua New Guinea (Fig. F1). The present-day tectonics of the region are the result of interactions between microplates caught in and formed during oblique convergence between the Pacific and Indo-Australian plates (Benes et al., 1994; Tregoning et al., 1998). Counterclockwise rotation