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RESEARCH ARTICLE
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Reconnaissance Basement Geology and Tectonics of South Zealandia

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Key Points:
- The first geological map of 1.5-Mkm^2 submerged South Zealandia reveals an E-W striking batholith with similar age pattern to Marie Byrd Land
- The 1,600-km-long Campbell Magnetic Anomaly System is interpreted as due to failed rift mafic magmatism that preceded 80 Ma Zealandia breakup
- Variation of extension direction over 20 Ma allowed this large area to thin considerably before breakup and formation of new ocean crust

Supporting Information:
- Supporting Information S1

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Abstract We report new U-Pb zircon ages, geochemical and isotopic data for Mesozoic igneous rocks, and new seismic interpretations of mostly submerged South Zealandia (1.5 Mkm^2). We use these data, along with existing geological and geophysical data sets, to refine the extent and nature of geological units. Our new 1:25 M geological map of South Zealandia provides a regional framework to investigate the rifting and breakup that formed Zealandia, Earth's most submerged continent. Samples of prerift (pre-100 Ma) plutonic rocks can be matched with on-land New Zealand igneous suites and indicate an east-west strike for the subduction-related 260 to 105-Ma Median Batholith across the Campbell Plateau. The plutonic chronology of formerly contiguous plutonic rocks in West Antarctica reveals similar pulses and lulls to the Median Batholith. Contrary to previous interpretations, the Median Batholith does not coincide with the 1,600-km-long Campbell Magnetic Anomaly System. Instead we interpret the continental magnetic anomalies to represent a mainly mafic igneous unit, whose shape and extent is controlled by synrift structures related to Gondwana breakup. Correlatives of some of these unsampled igneous rocks may be exposed as circa 85 Ma alkalic volcanic rocks on the Chatham Islands. Extension directions varied by up to 65° from 100 to 80 Ma, and we suggest this allowed this large area to thin considerably before final rupture to form new oceanic crust. Synrift (90–80 Ma) structures cut the oroclinal bend in southern South Island and support a pre-early Late Cretaceous age of orocline formation.

1. Introduction

Zealandia is a 4.9-Mkm^2, 94% submerged continent located in the SW Pacific Ocean and was formerly part of Gondwana (Mortimer, Campbell, et al., 2017). There are several first-order questions posed by Zealandia as the thinnest (crust) end-member of continents (12–24 km; Grobys et al., 2008; Mortimer, Campbell, et al., 2017). How is it possible to extend continental lithosphere over such wide areas before rupture? Can Zealandia's fringes be compared with typical volcanic-rifted or magma-poor continental margins? Why is West Antarctica (much of which is also highly thinned and a former part of Gondwana; Chaput et al., 2014) not a part of Zealandia? Answers to these questions require a knowledge of the crystalline basement geology of the southern part of the Zealandia continent (Figure 1).

South Zealandia is an ~1.5 Mkm^2 region of continental crust on the Pacific Plate (the only other continental crust on the Pacific Plate is in coastal California and Baja California; Mortimer, Campbell, et al., 2017). South Zealandia includes the South Island of New Zealand, the Chatham Rise, and Campbell Plateau (Figure 1). Pre-Cenozoic geological samples are available from only 21 scattered locations in six island groups (Chathams, Snares, Auckland, Campbell, Bounty, and Antipodes), nine petroleum exploration wells (Clipper-1, Takapu-1, Solander-1, Rakiura-1, Pukaki-1, Pakaha-1, Parara-1, Hoiho-1C, and Kawau-1), and six dredge sites (Takahe and Stuttgart seamounts, Mernoo and Matheson banks, Bounty Platform, and southern Campbell Plateau tip; Figure 1). Submarine basement exposure is limited because a widespread Cenozoic sediment drape over the generally relatively low-relief Campbell Plateau hinders dredging (Summerhayes, 1969). Rocks from most of the above localities have been described previously (Adams, 1983, 2008; Adams & Robinson, 1977; Adams et al., 2008; Beggs, 1978; Beggs et al., 1990; Cook et al., 1999; Cullen, 1965, 1975; Denison & Coombs, 1977; Field & Browne,

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