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The Pacific-Antarctic Ridge between 41deg S and 53deg S: hot underlying mantle evidenced by bathymetry and gravity studies coupled to geochemical results

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During the PACANTARCTIC 2 cruise (January 2005), the geomorphology of the Pacific-Antarctic Ridge was mapped using multibeam bathymetry and imagery between 53° and 41° S together with along axis gravity measurements and dredges. The ridge axis generally deepens in this region from the south towards the north. Analysis of the bathymetric, gravity and geochemical data reveal, south of the Menard Fracture Zone, three distinct ridge segments (S1-S3) respectively 220, 100 and 120 km-long from south to north, separated by non transform discontinuities. From the north of the fracture zone to 41°S, five segments (N1-N5), 110 to 260 km-long, are present. Two segments (S2 and N2) seem to be transitional segments between fully developed and more robust ones. Calculation of the cross-sectional area from the bathymetric data allows quantification of the variation in size of the central bathymetric anomaly. It yields information about the inflation of the ridge and therefore its magmatic-tectonic state. The mantle Bouguer anomaly can be calculated by subtracting the gravity anomaly predicted from a model which includes the seafloor bathymetry and a simple one layer crustal model from the observed free-air gravity anomaly. It provides information about regions of anomalous mantle temperature or crustal thickness. Both parameters give evidence that two segments of the ridge at 49°S and 50°S near major off-axis volcanoes on each part of the Menard FZ are underlain by anomalously hot mantle. At these places, the dome is robust, reaching 10 km in width and 400 m in height south of Menard FZ and 8 km in width and 300 m in height north of Menard FZ. Geochemical analyses of samples dredged during the survey show a close correlation of high cross-sectional area values, positive mantle Bouguer anomalies with enriched volcanism along the two segments of the axis close to the Menard Fracture zone.