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Unveiling signs of old supercontinents by satellite gravity gradients and curvature attributes with special focus on Antarctica

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The tectonic setting of Antarctica is still not completely understood due to the absence of comprehensive geological data. The lack of detailed information about major tectonic boundaries and subsurface geology under the Antarctic ice cap is still hindering our knowledge about the place of East Antarctica in the Gondwana supercontinent evolution.
Here, the potential of satellite gravity gradients is analysed in order to delineate tectonic boundaries within a plate tectonic framework of the Phanerozoic with special emphasis to Antarctica. From the satellite gradients curvature attributes like Shape Index are computed and analysed for Antarctica and adjacent plates. The Shape Index is a qualitative description of the shape of the local morphology and seems to coincide with the boundaries of the cratonic cores of the continents and the various kinematic structures of the oceanic lithosphere. The isostatic anomaly of curvature reveals structures with smaller wavelength.
We implement the selected attributes: Shape Index, Minimum Curvature and Vertical Gradient, proved to be useful in detecting the tectonic boundaries or geological provinces as tectonic features of various continents and tectonic plates into the plate tectonic software GPlates. Fault zones and Proterozoic terranes, which are derived by terrestrial and airborne gravity and magnetic data, are correlated with the isostatic anomaly of curvature attributes in a Gondwanan setting of Australia and Antarctica. Whilst the correlation with geological provinces of East Antarctica is challenging, we observe a clear correlation of the isostatic anomaly of curvature with Proterozoic terranes of Australia. We suggest that the curvature “attribute” is a useful geophysical algorithm that can extract geological information from present day geophysical data, information that can be used to better understand the tectonic evolution of remote and glaciated regions on Earth.