Seafloor spreading in the West Enderby Basin during initial breakup of Gondwana

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The seafloor spreading evolution in the Southern Indian Ocean is key to understanding the initial breakup of Gondwana. However, marine geophysical data are sparse and the seafloor spreading history is still speculative, especially in the Enderby Basin, the Southern Indian Ocean. We obtained new constraints on the seafloor spreading evolution in the West Enderby Basin by the lineaments deduced from the GEOSAT 10 Hz sampled raw altimetry data and magnetic anomaly lineations from the vector magnetic anomalies as well as satellite derived gravity anomaly map.

Tectonic lineaments with NNW-SSE strike, possibly indicating the fracture zone trend, are observed in the southern portion of the West Enderby Basin, to the east of Gunnerus Ridge, near the Antarctic Continent. Magnetic anomaly lineations, possibly belonging to the Mesozoic magnetic anomaly sequence, are also recognized and they are almost perpendicular to the strikes of the tectonic lineaments. In contrast, NNE-SSW fracture zone trends and Mesozoic magnetic anomaly sequence have been reported to the west of Gunnerus Ridge near the Antarctic Continent.

NNE-SSW trending parallel lineaments, which most likely are fracture zones, are found between the Gunnerus Ridge and the Conrad Rise. Magnetic anomaly lineations, possibly belonging to the Mesozoic magnetic anomaly sequence, are also recognized and they are almost perpendicular to the strikes of the tectonic lineaments. The lineaments are bounded by WNW-ESE lineaments on both north and south sides, and they form rectangular segments continuously aligned from west to east. Around 60S between the Gunnerus Ridge and the Conrad Rise, WNW-ESE structural lineaments transect the NNE-SSW lineaments perpendicularly at almost the center of each rectangular segment. Those structures are regarded as an extinct ridge system that created the NNE-SSW oriented fracture zones between the Gunnerus Ridge and the Conrad Rise. The existence of the extinct ridge system implies that major ridge reorganization occurred before magnetic anomaly No. 34.

The sea floor structural trend in the south of the Conrad Rise was different from the previously assumed NNE-SSW spreading direction of the West Enderby basin. Magnetic anomaly lineations almost perpendicular to the strikes of the structural trends are also detected in the south of the Conrad Rise. The seafloor in the south of the Conrad Rise may have been created during initial breakup of Gondwana and separated by the development of the extinct ridge system that formed the NNE-SSW trending fracture zones between the Gunnerus Ridge and the Conrad Rise. These results suggest complicated initial breakup process of Gondwana in the West Enderby Basin.