GPS Measurement of Tectonic Deformation and Isostatic Rebound in Marie Byrd Land, Antarctica

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The Ross embayment and western Marie Byrd Land are part of the West Antarctic rift system. The region is undergoing active deformation, but the rates and causes of deformation are essentially unknown. In December 1998 we installed three continuous and autonomous global positioning system (GPS) stations on outcrops in western Marie Byrd Land, with baselines between stations of about 100 kilometers. We recovered data for the sites in Marie Byrd Land during the 1998–1999 season and additional data in November 1999, November 2000, and January 2001. Velocity results from the first year are inconclusive, but suggest that spreading is occurring across the Ross Embayment. Our results indicate that MCM4 (McMurdo), about 1000 km from the network, is moving south 7±13 mm/yr, west 15±24 mm/yr, and up 3±44 mm/yr relative to MBL1, located 874 km to the east in the Rockefeller mountains. The errors are scaled 1σ errors (by a factor of 1.8) such that the χ2/dof is one in the velocity solution. Examined in a different way, the baseline between MCM4 and MBL1 is lengthening at a rate of 17±22 mm/yr and the stations are moving transverse to each other at a negligible rate of 2±16$~mm/yr. The low vertical rate between the two stations lends confidence that the solution is fairly robust. We plan to present a solution that includes data from the 2000–2001 season. The results will help determine whether active tectonic deformation is occurring in the Ross embayment. Crustal uplift could be occurring in western Marie Byrd Land due to isostatic rebound following the last glacial age. Tectonic extension, occurring in the embayment, could greatly influence global plate circuit calculations and constrain our understanding of the history of extension in the embayment and the consequent uplift history of the Transantarctic Mountains.