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GPS constraints on Antarctic Ice Mass Fluctuations

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Global Positioning System (GPS) measurements at bedrock sites in Antarctica hold the potential for partially testing chronological models for the mid-to-late Holocene (8-0 Ka) collapse of the West Antarctic Ice Sheet. A network of permanent GPS sites exists in Antarctica mainly at coastal sites, but sites in the interior of Antarctica, near present and paleo ice accumulation centers, are key to shedding light on the history of the Antarctic ice sheet. Considerable effort has been expended by several groups of investigators during the last decade to acquire these data. These efforts have resulted in several new data points with which to test current models of postglacial rebound. We have collected data quasi-continuously between November 1996 and January 2001 at two autonomous GPS stations in the northern Transantarctic Mountains, and between November 1998 and January 2002 at three stations in Marie Byrd Land. Significant vertical rates were resolved at Mt. Coates in the Dry Valleys (4.5 +/- 2.3 mm/yr), and in the Rockefeller Mtns (11.8 +/- 4.0 mm/yr) and Clark Mtns (7.4 +/- 4.1 mm/yr) in Marie Byrd Land. These uplift rates are most likely due to glacial isostatic motion. Uplift at Mt. Coates deviates significantly from uplift predictions based on deglaciation models ICE-3G and ICE-4G, but is consistent with the D91-1.5 model of variable and continued ice sheet ablation to 2 kyr and a viscosity of 10^{21} Pa s in the upper mantle and 10^{22} Pa s in the lower mantle beneath the region. The range of upper mantle viscosities indicated by the deglaciation model that includes persistent drawdown to 2 kyr suggests a subcratonic upper mantle. Uplift rates at sites in Marie Byrd Land are not consistent with any of the previously mentioned models, but are consistent with collapse of the nearby Roosevelt Ice Dome at 4 Ka. Data from permanent sites around Antarctica are consistent with the response of a stiffer rheology in East Antarctica while anomalous high uplift rates in West Antarctica are more consistent with pre-

dictions of the IJ05 model and a weaker rheology. High-quality uplift data from the interior of the continent are key to providing stronger constraints on both deglaciation history and Earth rheology. Longer and more continuous time series from a network of stations that sample the spatial gradients in uplift are needed to advance better models of glacial isostatic adjustment and complement GRACE estimates of present-day ice mass change in Antarctica.