PRELIMINARY INTERPRETATION OF SIX YEARS OF TILTMETER MOTIONS ABOVE THE FLANKS OF THE SOCORRO MAGMA BODY, CENTRAL RIO GRANDE RIFT

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Three shallow (3 m) biaxial borehole tiltmeters in place around the margins of the uplift above the Socorro Magma Body (SMB) since 2002 show near-surface ground motions at several temporal scales. Two tiltmeters are located in narrow grabens of the Rio Grande rift about 15-20 km north and south of the center of historic uplift near San Acacia. The north station is in a symmetrical graben; it may be more responsive to magmatic tilt than tectonic tilt. A third tiltmeter at Silver Creek is located on a west-tilted rift block about 15 km west of San Acacia, where magmatic uplift and tectonic tilt should be additive.

The tiltmeters (Applied Geomechanics model 722) with selectable gain and output range of ± 2500 mV are set at high-gain resolution of ± 0.1 microradians over a range of ± 800 microradians. Readings of North-South and East-West tilts, as well as temperatures are taken every 30 seconds and the average recorded every 20 minutes. The western datalogger also records local precipitation. The tiltmeter records show: 1) earth-tide cycles of 10ths of microradians on the order of two per day, 2) surface waves of distant moderate-to-large earthquakes that affect tilt averages over 20-40 minutes, 3) 10- to 20-day abrupt excursions following large precipitation events, 4) 10-14 month wave-like variations perhaps related to lagging seasonal temperature gradients at depth of burial, 5) a few abrupt excursions of uncertain origin, and 6) multi-year long-term changes in average tilts, both in direction and magnitude. The last type of tilting may be related to transient motions of either structural blocks within the Rio Grande rift above the SMB, and/or “heavy breathing” of a smaller shallow magma body as suggested by GPS data collected since 2003 (Newman et. al, 2004). "Heavy breathing" is a common metaphor for alternating magma chamber inflation and deflation over periods of several years or decades, as observed in the vicinity of several "restless" Quaternary calderas.

When viewed together in a relative and qualitative sense, averaged tiltmeter data for stations north and west of San Acacia suggest a period of magmatic uplift (inflation) was occurring from the fall of 2002 to the summer of 2004. Tilting dominantly toward San Acacia from the summer of 2004 to the fall of 2006 may represent a period of magmatic deflation. Inflation may now be ongoing.

The apparent motions of local fault blocks are clearly not unidirectional and when viewed in an absolute sense some patterns seem counterintuitive. Clearly, longer-term records of tilt and perhaps more tiltmeters are warranted. Tiltmeter data may ultimately be temporally correlated to surface motions currently being measured by nearby continuous GPS stations and new INSAR data.

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