Model Fit to Negative Magnetic Anomaly over Mt. Resnik, a Subaerially Erupted Volcanic Peak Beneath the West Antarctic Ice Sheet, Partially Constrains the Ages of Subglacial Volcanism.

John C. Behrendt,1,2 Carol A. Finn,2 David Morse,3 Donald D. Blankenship3
1INSTAAR, University of Colorado, Boulder
2U.S. Geological Survey Denver, Colorado
3Institute for Geophysics, University of Texas, Austin

Mt. Resnik, a conical peak (likely a subaerially erupted volcano) 300 m below the surface of the West Antarctic Ice Sheet (WAIS), has ~2 km topographic relief defined by radar ice-sounding of bed topography; it is associated with a complex negative magnetic anomaly revealed by the Central West Antarctica (CWA) aerogeophysical survey. We interpret a magnetic model fit to this anomaly as a volcanic source comprising reversely magnetized (in the present field direction), 0.5-2.5-km thick volcanic flows at the summit overlying normally magnetized flows and a subvolcanic intrusion. The Mt. Resnik 305-nT negative anomaly is part of an approximately 45- by 35-km 600-nT positive anomaly complex extending ~30 km to the west of the Mt. Resnik peak, associated with an
underlying source complex of about the same area, whose upper surface is at the bed of the WAIS. However the bed relief of this shallow source complex has a maximum of only ~400 m, whereas the underlying modeled source is >3 km thick. From the spatial relationship, we interpret that this source and Mt Resnik are approximately contemporaneous, but that any subglacially (older?) erupted edifices comprising hyaloclastite or other volcanic debris, which formerly overlaid the source to the west, were removed by the moving WAIS into which they were injected.

The Mt. Resnik volcano was erupted subaerially, during a time of magnetic field reversal from normal to reversed polarity at least as old as 780 Ka (the Brunes-Matuyama reversal). Mt. Resnik is one of five peaks to have an associated negative magnetic anomaly of the previously reported 18 inferred subaerially erupted volcanoes, which have high bed topography beneath the WAIS. There are ~100 short-wavelength, steep-gradient, negative magnetic anomalies observed in the CWA survey, or ~10% of the approximately 1000 short-wavelength, shallow-source, high-amplitude (50->1000 nT) "volcanic" magnetic anomalies observed in this survey. These negative anomalies indicate volcanic activity during a period of magnetic reversal and therefore must also be at least 780 Ka.

The earlier reported (1994) minimum volume of 10 million cubic km of volcanic centers (primarily subvolcanic intrusions) associated with the ice-covered West Antarctic rift system (WR) interpreted from the CASERTZ aeromagnetic survey appears to still be valid now that 10 times more data are available, and implies a large igneous provence of interpreted late Cenozoic age. While the age of the known volcanism in the WAIS area of the WR extends from the present to ~30 Ma and the WAIS has been active since >10 Ma, the age of the ice in the WAIS is 100-200 Ka at most.