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Identification and classification of sub-volcanic systems under Greenland's Ice Sheet

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The Greenland Ice Sheet may be undergoing enhanced melting at the head of Greenland's only fast flowing ice stream, the NE Ice Stream, by an anomalous high heat flux. The source of this high heat flux is poorly understood, but indicates the presence of an active or formally active volcanic system not previously investigated. Characterization of this source of high heat flux is necessary to determine primary behavioral controls of the ice stream as well as to determine any unknown hazards that may be associated with a subglacial volcanic system. Potential field geophysical data from regional geophysical mapping is available to isolate probable locations of the heat source. Free air gravity and total magnetic field data are to be used to isolate areas of high gravity coupled with magnetic signatures that indicate the presence of a magnetic body at the head of NE Ice Stream. 3D potential field modeling will be used to determine the geometry and the geophysical properties of the overlying bedrock and the supposed volcanic body from total magnetic field, free air gravity and surface and bed elevations centered over the anomaly. A heat transfer model will used to calculate a temperature range of the body using the layer rates estimated by Fahnestock et al (2001). An internal temperature above 700°C will indicate a partially molten body and therefore an active volcanic system. Other gravity and magnetic anomalies along the ice stream will also be investigated. Ice penetrating radar data will be examined to study subglacial geomorphology and detect any bed surface features that may indicate the presence of volcanic edifices, caldera structures or a volcanic field. Structures and anomalies will be analyzed for lineations, groupings, and other patterns that may indicate an overall behavior of the system as a caldera system, volcanic field or local rifting from the ice sheet overburden on the crust. Similar anomalies in Antarctica with strong indication of volcanic systems play an important role in ice dynamics, ice stream behavior and ice sheet evolution. Characterization of a previously uncharacterized volcanic system in Greenland opens further research into the controls of the NE Ice Stream as well as identifying a previously unknown hazard.