The ~~Complex~~ Relationship Between Antarctic Meteorite Concentrations and Ice Velocity

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Background

The Antarctic Search for Meteorites (ANSMET) program has been recovering meteorites from blue ice areas along the Trans-Antarctic Mountains since 1976. It was recognized early that concentrations of meteorites were associated with ice that was slow moving or stagnant, and which have been referred to as meteorite standing surfaces. Modest programs by ANSMET to measure and quantify ice velocities at a couple of stranding sites have confirmed this association.

Satellite remote sensing has the power to measure ice velocities on a continent-wide scale. Rignot, et al. (2011) offered a first glimpse of ice velocities of the Antarctic icesheet. Recently, Mouginot, et. al. (2019) released a version derived from interferometric Synthetic Aperture Radar(InSAR) phase data acquired over a period of several years at a spatial resolution of 450 meters of the entire Antarctic continent (Figure 1).

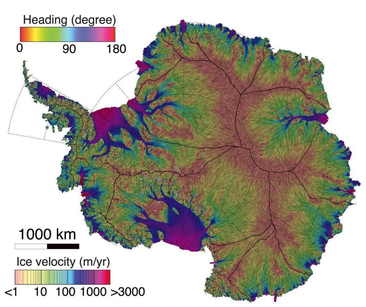

Figure 1. Ice velocity and vectors of the Antarctic Icesheet . (Mouginot et. al. 2019).

Meteorite Stranding Sites and Ice Velocity

For meteorite standing surfaces to exist, icesheet topography must be present that influences katabatic winds to erode the glacier's surface of overlying snow and firn, exposing the deep glacial ice to ablation. This condition needs to prevail for long periods of time. The next requirement is that the suitable area must have very low ice velocities which, again, must necessarily have persisted for millennia.

We have taken meteorite location data and incorporated it with portions of the ice velocity dataset for selected areas in which ANSMET has been operating. The data strikingly shows the intimate relationship of meteorite stranding sites and ice velocity.

To produce the ice velocity maps of the selected regions containing significant meteorite stranding sites we used ArcGIS to display the meteorite locations on the georeferenced velocity map. The ice velocity data were then reclassified in order to emphasize the spatial distribution of ice velocities of less than 9 meters/yr.

Figures 2 and 3 show the 18 significant meteorite concentration/find sites in the Beardmore Region and 15 localities in the Scott Glacier region.

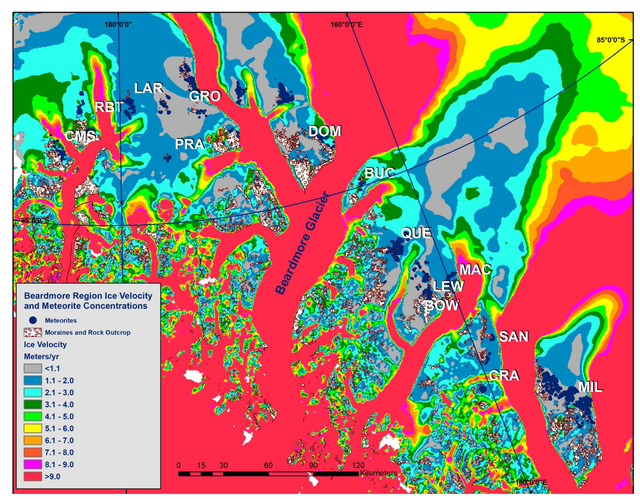

Figure 2. Beardmore Region ice velocity and meteorite find localities.

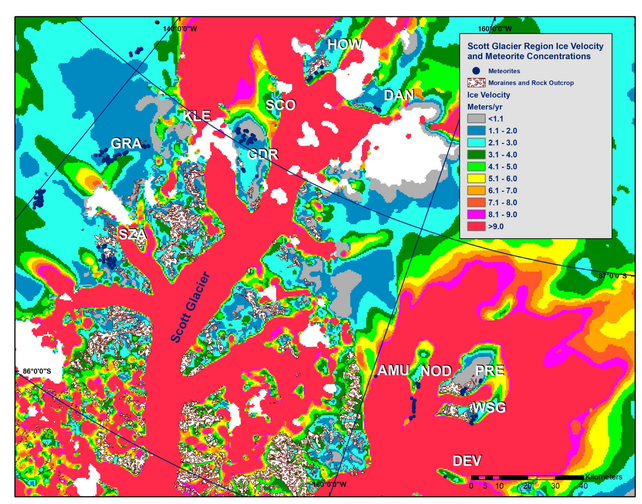

Figure 3. Scott Glacier Region ice velocity and meteorite find localities. White polygons are No Data.

Figure 4 shows three different meteorite stranding sites in the Upper Beardmore Glacier area. The Scott Icefalls Icefield meteorite concentration is found on very slow stagnant ice trapped between two faster moving tributaries of the Mill Glacier. The Davis-Ward Icefield ice tongue terminates up against faster ice mass cutting across its flow direction. The Dominion Range Main Icefield is stagnant ice which is isolated from the flow of the Beardmore Glacier by a significant shear zone.

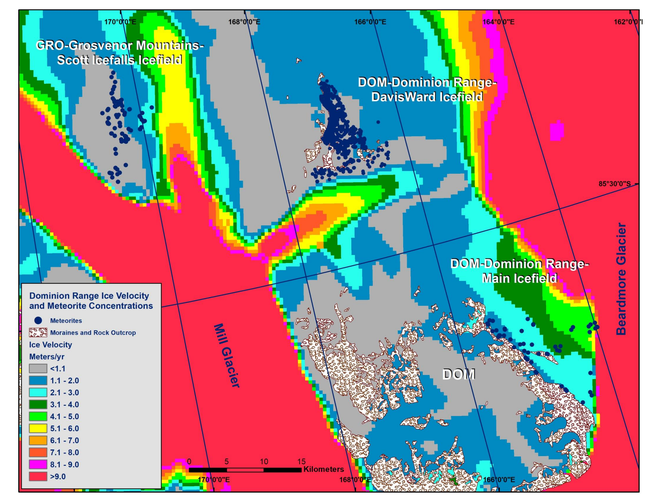

Figure 4. Dominion Range - Upper Beardmore Glacier area ice velocity and meteorite find localities.

Acknowledgments

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The dataset used in **this work is publicly available through the National Snow & Ice Data Center via https://nsidc.org/data/NSIDC-0754/versions/1.**

References

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