AIRBORNE GEOMAGNETIC INVESTIGATIONS AT THE HAUGHTON IMPACT STRUCTURE, DEVON ISLAND, NUNAVUT, CANADA: NEW RESULTS. B. J. Glass[1], P. Lee[2,1] and G. Osinski[3], [1] NASA-Ames Research Center, Moffett Field, CA 94035, USA; [2] SETI Institute, 2035 Landings Drive, Mountain View, CA 94043, USA. [3]Planetary and Space Science Centre, Dept. of Geology, University of New Brunswick, Fredericton, NB E3B 5A3, Canada. (**bglass@mail.arc.nasa.gov**)

Introduction: The ~23Ma Haughton impact structure [1], centered at 75° 23'N, 89° 39'W on Devon Island in the Canadian Arctic, is a well-preserved structure with an original rim diameter estimated at ~24km [2]. Preliminary results from a recently-completed airborne geomagnetic survey of the structure and surrounding terrains are presented here. The purpose of this investigation was to extend and complete the broad magnetic map begun in [3], comparable to the gravity map given in [4], in order to characterize the geomagnetic signature of the Haughton structure. Mapping extended into surrounding terrains over an area of 75x60km in order to clearly delineate any feature associated with the impact structure.

Background: A fairly-detailed gravity survey of the Haughton structure was completed in 1984 with 341 data points [4] and found a large negative Bouguer anomaly (-12 mgal, 24 km radius) characteristic of impact structures, with a central local minimum. However, geomagnetic field measurements at that time were limited to several 3-4 km ground profiles taken along NW-SE and NE-SW transects in the vicinity of the local central anomaly, and they lacked a local base station magnetometer to correct for temporal variation in the ambient magnetic field. Those results showed a positive magnetic total field anomaly of 700 nT at the central anomaly. The gravity low and magnetic high were postulated in [4] as likely due to highly shocked and altered sedimentary and crystalline basement rocks in a central uplift area.

The NASA Haughton-Mars Project (HMP) is a Mars-analog field research program studying the Haughton structure since 1997. Geological, geophysical and biological characterizations of the Haughton structure are its science focus, as well as the use of the site as a Mars analog for testing future mobile instruments and platform technologies (e.g., Mars aircraft or rover-deployed magnetometers, synthetic-aperture radar, remote data communications, etc.). Parallel HMP geological studies at Haughton include investigations of the fault structure and evidence of post-impact hydrothermal activity. Early hydrothermal study results [5] have found pipe structures associated with the faulted annulus, as well as cavity and fracture fillings within the impact carbonatitic melt sheet [6].

Earlier partial geomagnetic surveys [3,4] found a central magnetic high with bounding lows, which would be compatible with a central uplift with local basement anomalies. The co-location in [5] of discovered pipe structures and hydrothermally-worked specimens with the annular edge magnetic anomalies in [3] was suggestive, but a broader geomagnetic survey was needed to characterize the regional trends.

Results: This survey was flown on July 20-23, 2001 at the Haughton impact structure, covering 2150 line-km. A helicopter-borne vertical magnetic gradiometer system was used, using two Geometrics G822 cesium vapor magnetic field sensors (with 0.01 nT sensitivity at a 10Hz sampling rate) mounted 2m apart in a towed airfoil. Navigation relied on differential GPS and a radar altimeter (Honeywell AA330). A comparable magnetometer was used on the ground to capture diurnal field variations, located 400m away from the HMP base camp to minimize impingements from moving ferrous objects in the camp. Magnetic line data was corrected for diurnal variations and the survey set was leveled using the flight-line and tie-line constraints. The corrected data was interpolated between the 1km-separate survey lines using random point gridding with a minimum curvature algorithm in Geosoft's OASIS software. Infill survey lines were flown over the central anomaly at spacings of 250m. One of the resulting regional total field contour plots is given in Figure 1(a).

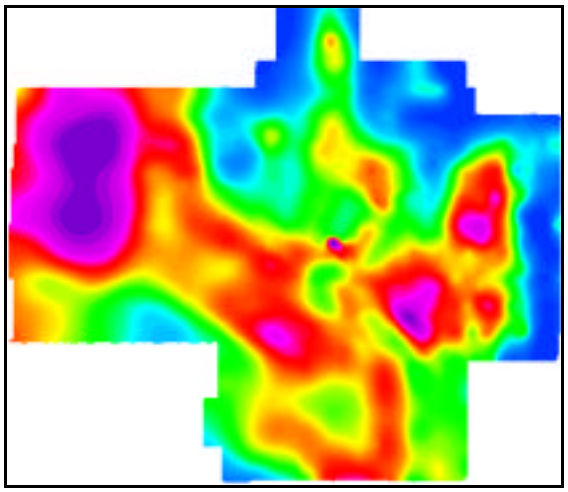

Fig. 1(a) Regional aeromagnetic contour plot, total field. Impact structure is at center.

For comparison, Figure 1(b) is taken from the 1999 survey [3], showing the total magnetic field

over the central crater area (83 59300N, 4 18500E to 83 75200N, 4 31200E). Flight lines show the spacing of the flight and tie lines respectively. Other surveys (not shown) were also flown at higher resolution over the central anomaly area and the northwest quadrant of the plot in Figure 1, and vertical magnetic gradient plots have also been created for each survey.

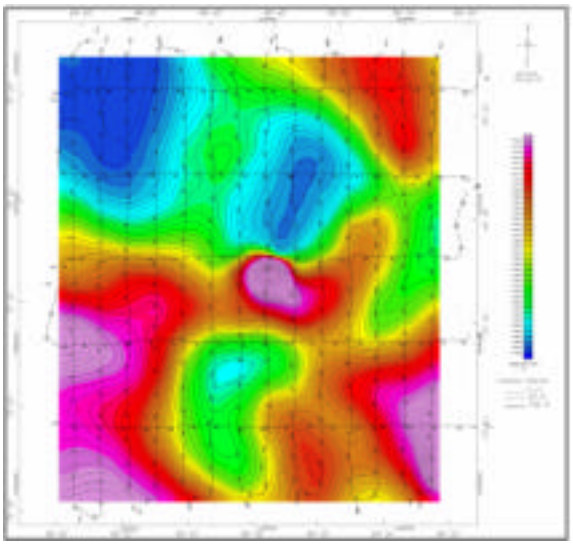

Fig. 1(b). Total magnetic field (1999 survey, [3]) showing center anomaly detail.

As shown in Figure 1(a) and 1(b) there is a discernable central magnetic anomaly, consistent with earlier studies, with slight vergence toward the NW. However, Figure 1(a) shows that this central anomaly is of comparable magnitude (300-500 nT) to regional patterns. The differentiating metric between the central anomaly and regional structures seems to be areal extent – the central anomaly features are approximately 3km, while the regional structures are roughly 8-20km.

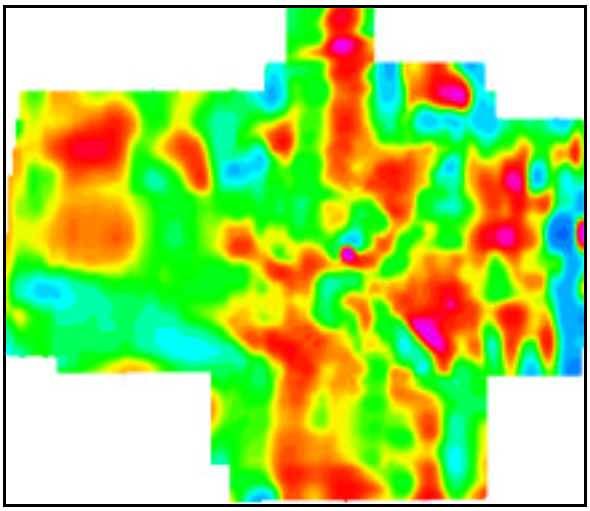

Fig. 2. Regional contour plot of the vertical magnetic gradient.

Examination of vertical magnetic gradient data, such as shown in the contour plot in Figure 2, also indicates that the impact-induced magnetic anomalies are of similar magnitude to regional patterns**.** And while hydrothermally-worked specimens have been found thus far in the areas corresponding to the positive anomalies roughly 10km NNE, SW and SE of the central anomaly [3], these anomalies are of comparable areal extent and hence do not appear differentiable from the regional vertical gradient patterns.

Discussion: The new data is consistent with previous results showing a central magnetic high with bounding lows within the crater, compatible with a central uplift with local basement anomalies. Regional trends appear to be of comparable magnitude to the rim area anomalies, so it is not possible to conclude (or disprove) that the rim-area magnetic anomalies are associated with the discovered hydrothermal deposits in those areas. The regional magnetic high shown in the west in Figure 1(a) may merit further examination. And a regional gravity survey with current instruments would be highly desirable for modelling and analysis.

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