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Introduction

We present an example of three-component ROV ISIS magnetic field data (S1) and a crossing tie-line profile (S2) for data quality assurance and to support our data analyses. We also present a complementary plot to support our discussion of the inversion phase test for block rotation (S3).

Figure S1. An example of three component magnetic field data of Dive67_1 profile after the vehicle induced magnetic field correction (see Section 3.3) (Vertical axes are in units of nanoTeslas, horizontal axis are in units of kilometers (km). Three component magnetic data of Dive67_1: X (top), Y(middle), and Z(bottom) axis data. Note that the convention of the x-, y-, and z-axes follows the manufacturer of the magnetometer sensor (Honeywell HMR2300) and
how it was installed and recorded on ROV ISIS and does not follow the geomagnetic
convention of X-, Y-, and Z.

Figure S2. Cross track tie-line check between ISIS Dive 67 and 71 (see orange lines in Figure
3A). All the profiles/values are after vehicle-induced magnetic field calibration, IGRF and
diurnal correction. Both eastward (blue) and westward (pink) lines indicate a part of Dive 71
profiles that crossed four lines Dive 71_2 (leftmost black dots), Dive 71_1 (black dots, second
from the left), Dive 67_1 (black dots, third from the left), and Dive 67_2 (black dots, rightmost).
The match between these and all of the cross lines (black dots) indicate our calibration process
was successful and that there is no significant discrepancy or offset in between dives. Vertical
axis has units of nanoTesla, horizontal axis has units of longitude degrees.

Figure S3. Testing phase-shift of inversion results: (left) inversion results (Fig.6A); (middle) 45°
phase shift; and (right) 90° phase shift. There are only modest changes in the overall
magnetization pattern although the 90° phase shift produces unreasonably large intensities.