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A Positive Magnetic Anomaly at Rainbow Hydrothermal Site in Ultramafic Environment

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Most of the hydrothermal vent systems on basaltic substratum present a negative magnetic anomaly, i.e. a deficit of magnetization, related to either thermal demagnetization associated to the high temperature at the vents, or to alteration of the basalt titanomagnetite to less magnetized titanomaghemite, or both. Our investigation shows that hydrothermal vent systems on ultramafic substratum may be associated to strong positive anomalies instead, which origin is currently investigated. In May 2001, hydrothermal site Rainbow (MAR 36° 14'N) was explored through a variety of experiments using IFREMER deep-sea ROV Victor, including one long dive fully devoted to a Deep Sea Three Components Magnetometer survey. A total of 19 lines, 700-800 m long each and 60 m apart, were collected and covered quite densely the whole site area. The magnetic data were acquired about 1 to 10 m above seafloor, providing an ultra-high resolution never achieved so far on a hydrothermal system in ultramafic environment. Both the magnetic effects from the ROV and the main geomagnetic field were evaluated and removed. The absolute magnetization of the seafloor was estimated in the following way. First, synthetic magnetic anomalies were calculated along the ROV tracks, assuming a local 2D topography (as given by the immersion and altitude of the ROV) and a unit (1A/m) magnetization of the seafloor. Then observed and synthetic anomalies were compared on sliding windows, and if the coherence between both signals is high, an estimate of the magnetization is given by the ratio between observed and modeled anomalies. Surprisingly, site Rainbow exhibits a very strong magnetization (higher than 28 A/m). Although this observation can be explained either by the formation of magnetite during the serpentinisation process or by formation of highly magnetic minerals within the sulfurs in relation to the peculiar settings of the site, preliminary rock magnetic analysis of representative samples suggests that the major magnetic bearer is magnetite located within sulfurs impregnating the altered ultramafic rocks.