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Marine geomagnetic high definition metrology; possible archaeological applications

The marine geomagnetism is often used to solve geological problems at a regional scale: structural, volcanological or mining problems, for instance (Faggioni et al., 1995).

In recent time, the development of the *"high definition (HD) metrology"* (Faggioni et al., 2001) has made the marine geomagnetic method suitable for detecting short wavelength and low amplitude geomagnetic anomalies. This type of signal may be often related to environmental and/or archaeological sources. The improvement of the informative power of marine geomagnetic signal is mainly due to the time reduction accuracy (Faggioni et al., 1997), to the quantitative classification of the high frequency geomagnetic anomalies, to their bottom (*BTM*) reduction (Faggioni et al., 2001) and their effective inversion (Caratori Tontini et al., 2003).

In this study a first application of the *HD* metrology to marine magnetic data collected on bodies that very well simulate sources of archaeological interest is presented and discussed. The surveyed area is located in the eastern side of the Ligurian Sea (Italy) south of the point having 44°05'00'' as latitude and 09°45'00'' as longitude. In this area a wreck (II war armed merchant ship) lies at a depth of 40 m from sea level.

A high sensitivity (0.02 nT) Geometrics G880 optical pumping magnetometer was used to collect the data. The geophysical investigation was carried out with the aim to recognize and define the magnetic anomalies due to the ship and to its cargo that scattered on the sea floor during the sinking (skeins of barbed wire). While the ship's hulk is easily recognizable, the skeins of barbed wire are not visible because sediments, having a thickness of 1.3 m on average, cover them.

In figure 1A, the *HD* magnetic anomaly field, after coherence analysis, time reduction and IGRF 2001 removal is shown; it is characterised by a complex shape due to the superposition of several high frequency signals. This map permits only a qualitative and approximate location of the metallic sources. To improve the informative quality of the geomagnetic anomaly map, data were transformed by applying first the spectral reference field (*SRF*) procedure (Faggioni et al., 2001) and then the *BTM* reduction. The result of this operation is given in figure 1B where the spectral anomaly field (*SAF*), with the highest wavelength $\lambda = 1.8$ km, is shown. In this map the two anomalies are well defined and isolated. While anomaly #2 is in correspondence of the location of the wreck with an estimated confidence of 100 m, anomaly #1 is placed, with a confidence of 50 m, in correspondence of a gentle undulation (about 2.0 m high) of the sea floor.

The subsequent direct submarine inspection finally explained the real nature of this little topographic high producing a relevant dipolar signal: no magnetic rocks but a share of the cargo lost by the ship and covered by sediments.

References

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