

# Estimation of the total magnetization direction of approximately spherical bodies

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We have developed a fast total-field anomaly inversion to estimate the magnetization direction of multiple sources with approximately spherical shape and known centres. Our method can be applied to interpret multiple sources with different magnetization directions. It neither requires the prior computation of any transformation like reduction to the pole nor the use of regularly spaced data on a horizontal grid. The method contains flexibility to be implemented as a linear or non-linear inverse problem, which results, respectively, in a least-squares or robust estimate of the components of the magnetization vector of the sources. Applications to synthetic data show the robustness of our method against interfering anomalies and errors in the location of the sources' centre. Besides, we show the feasibility of applying the upward continuation to interpret non-spherical sources. Applications to field data over the Goiás Alkaline Province (GAP), Brazil, show the good performance of our method in estimating geological meaningful magnetization directions. The results obtained for a region of the GAP, near from the alkaline complex of Diorama, suggest the presence of non-outcropping sources marked by strong remanent magnetization with inclination and declination close to  $-70.35^\circ$  and  $-19.81^\circ$ , respectively. This estimated magnetization direction leads to predominantly positive reduced-to-the-pole anomalies, even for other region of the GAP, in the alkaline complex of Montes Claros de Goiás. These results show that the non-outcropping sources near from the alkaline complex of Diorama have almost the same magnetization direction of that as the ones in the alkaline complex of Montes Claros de Goiás, strongly suggesting that these sources have been emplaced in the crust almost within the same geological time interval.