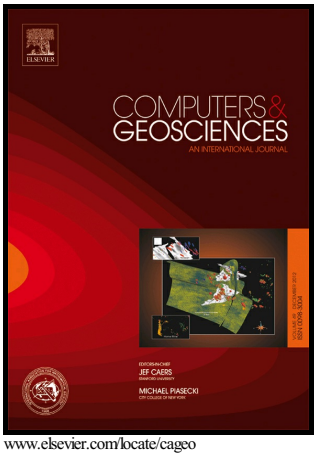

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D. Nathan, P. Duuring, E.J. Holden, D. Wedge, T. Horrocks

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Learning Characteristic Natural Gamma Shale Marker Signatures in Iron Ore deposits

Nathan, D.[1*], Duuring, P.[2], Holden E.J.[1], Wedge D.[1] and Horrocks T.[1]

[1] Centre for Exploration Targeting, The University of Western Australia, 35 Stirling Highway, Crawley WA 6009

[2] Geological Survey of Western Australia, Department of Mines and Petroleum, Mineral House, 100 Plain Street, East Perth WA 6006

[*]Corresponding author: david.nathan@uwa.edu.au

Abstract

Uncertainty in the location of stratigraphic boundaries in stratiform deposits has a direct impact on the uncertainty of resource estimates. The interpretation of stratigraphic boundaries in banded iron formation (BIF)-hosted deposits in the Hamersley province of Western Australia is made by recognizing shale markers which have characteristic signatures from natural gamma wireline logs. This paper presents a novel application of a probabilistic sequential model, named a continuous profile model, which is capable of jointly modelling the uncertainty in the amplitude and alignment of characteristic signatures. We demonstrate the accuracy of this approach by comparing three models that incorporate varying intensities of distortion and alignment in their ability to correctly identify a shale band of the West Angelas member of the Wittenoom Formation which overlies the Marra Mamba Iron Formation in the Hamersley Basin. Our experiments show that the proposed approach recovers 98.72% of interpreted shale band intervals and importantly quantifies the uncertainty in scale and alignment that contribute to probabilistic interpretations of stratigraphic boundaries.

Introduction

In the assessment of mineral resources the separation of a deposit in to geological domains is crucial to its feasibility. Moreover, the tendency of specifying domains based only on grade and not in unison with other geological parameters such as stratigraphic relationships and geometry can have detrimental consequences in final reserve estimates (Srivastava 2005). This can be more apparent in the estimation of tabular ore bodies, such as stratiform iron ore bodies, where blocks are commonly unfolded so that stratigraphic contacts are horizontal before geostatistical estimation (Sommerville et al. 2014; Abzalov 2016). The Hamersley province in Western Australia presents (Figure 1) a useful case where the stratigraphic interpretation of drill holes can be constrained by the natural gamma signature of the borehole and is thus routinely collected in the exploration of the region (Jones et al. 1973; Kneeshaw et al. 2003). The Brockman and Marra Mamba iron formations are interbedded with shale bands that are laterally consistent across the province and that have distinctive peaks in the natural gamma signatures that are preserved through the enrichment process. This has allowed standard references of natural