

Chemostratigraphic discrimination assisted by machine learning to enhance 3d modelling

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The most critical components of any successful mineral exploration campaign are a robust, reliable geological map and geological model. In this case study, the chemostratigraphy of the Esperanca South paleoplacer gold deposit of the Castelo De Sonhos plateau, Brazil, has been successfully delineated using machine-assisted modelling of four-acid geochemical data.

The Castelo De Sonhos (CDS) paleoplacer gold deposit is situated in the Pará State of northern Brazil. The CDS Formation is a relic of a sedimentary basin that likely formed near the coast, where sediments that were eroded from higher elevations accumulated in alluvial fans and, occasionally, aeolian dunes. U-Pb isotope dates from detrital zircons indicate that deposition of these sediments occurred 2.01–2.05 billion years ago in the Paleoproterozoic [1]. Most of the formation consists of medium to coarse-grained, cross-bedded sandstones that are described locally as metamorphosed arenites. At places within the formation, the size of the particles increases, and the formation becomes a true conglomerate [2].

The challenge in defining the stratigraphy at Castelo De Sonhos is that the metasediments were sourced from visually similar host rocks, therefore differentiating the stratigraphy was previously only possible based on textural differences. Introduction of four-acid geochemical data created an opportunity for a step-change in understanding at the project; for the first time, chemostratigraphy could be defined, a geochemical discrimination and machine-assisted classification could be produced, and a robust geological map as well as a 3d geological model could be established. Routine geochemical workflows, such as dimension reduction (PCA) and clustering, were employed to first identify the main geochemically distinct units, and then to refine channels and lobes within the main sedimentary pile.

[1] Klein, E.L., Rodrigues, J.B., Queiroz, J.D.S., Roberto G. Oliveira, R.G., Guimarães, S.B. and Chaves, C.L. (2017), “Deposition and tectonic setting of the Palaeoproterozoic Castelo dos Sonhos metasedimentary formation, Tapajós Gold Province, Amazonian Craton, Brazil: age and isotopic constraints”, *International Geology Review*, Volume 59, p.864-883.

[2] Vargas, A. M.; Campbell-Hicks, C.; NI 43-101 Technical Report MINERAL RESOURCE ESTIMATE UPDATE ON THE CASTELO DE SONHOS GOLD PROJECT PARA STATE, BRAZIL by CSA Global, 95pp. Effective Date September 13th 2017.