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Computer assisted drill hole data interpretation for iron ore exploration

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Identifying host-rocks and their alterations such as goethite and hematite in Banded Iron-Formation (BIF) settings from geochemical assays and wireline logs is an essential step in iron ore exploration.Here we present workflows that attempt to emulate the human interpretation process of this identification by using supervised learning pattern recognition methods. Importantly, this workflow provides ways to visually validate the automated classification outputs with the specific aim to improve confidence in their uptake by geologist.

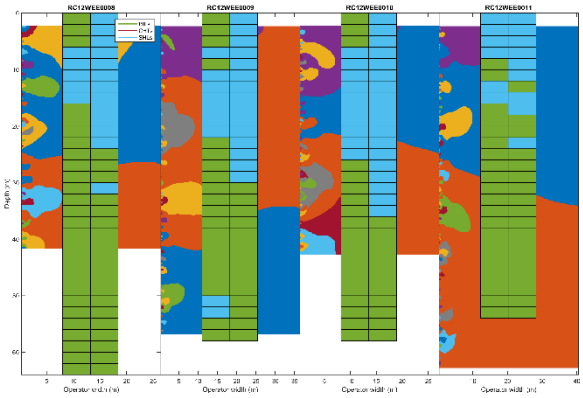

Figure 1: Host-rock classification and validation for iron ore. Logged and automated classification results for BIF (green) and shale (blue) intervals for four drill holes overlay the wavelet transform results of wireline density. Geological zone boundaries in classified host-rock intervals matched well with the location of pattern change in the wavelet transform.

Our case study uses drill hole data from the Hamersley Basin. First, we used a supervised learning pattern classification method, multi-class Support Vector Machines [1], to identify BIF and shale using four major XRF geochemical assays: iron, alumina, silica, and total loss on ignition (LOI). The classification result is validated by comparing geological zone boundaries identified by geophysical measurement, i.e. gamma-gamma wireline density as show in Figure 1. Due to the different scale between wireline (10cm) and geochemistry assays (2m), a wavelet transform technique [2] is applied to the wireline density to see pattern changed in varying scales, which may be associated with geological zone boundaries. Second, alterations (goethite and hematite) are automatically classified within BIF intervals identified by the first classifier. The geochemical grade definitions for alteration can be effected by many local factors and so the validation of these classification results is done through an unsupervised clustering approach [3]. This then allows the interpretation of trace

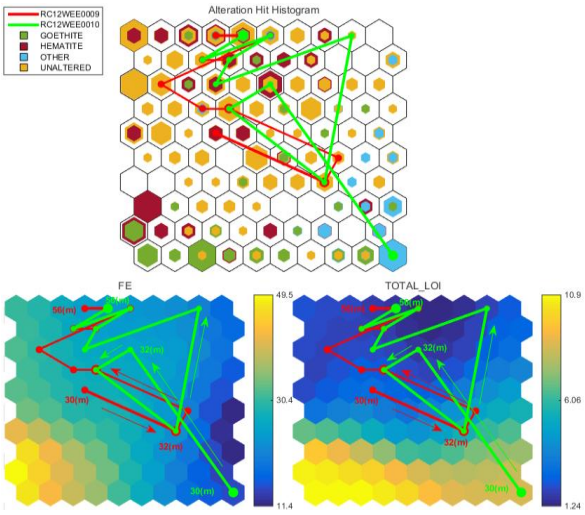

Figure 2 Alteration validation for two drillholes using Unsupervised Learning.

element signatures such as TiO2, Pb, Ni, Zn, and Ba to be incorporated to further evaluate more detailed stages of alteration.

References:

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