What happens when spatially sparse geochemistry meets dense mineralogy?
An example from the Eucla basement and its cover rocks!

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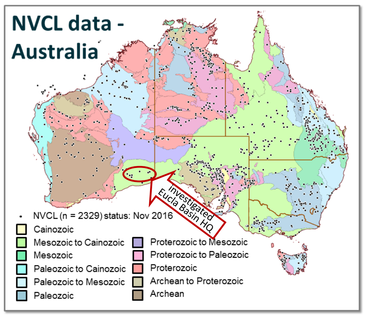
Introduction

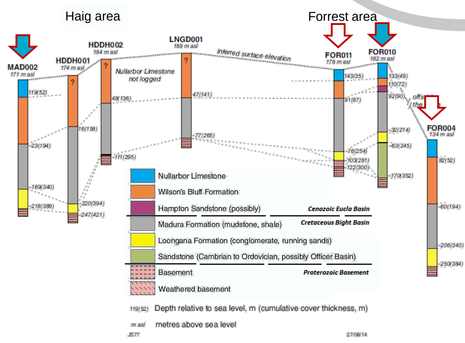


Publically available hyperspectral drill core data of the National Virtual Core Library (NVC) can be accessed via AuScope's Discovery Portal (http://portal.auscope.org/portal/gmap.html) and the respective State and Territory Geological Surveys.

Cretaceous and Cenozoic sediments cover a vast area of unknown Precambrian crust underlying the Bight and Eucla Basins. HyLogged drill core, obtained as part of GSWA's Eucla basement stratigraphic drilling program, provides valuable information about this underexplored area.

Particular attention was paid to the relationship between mineralogical and geochemical variations in the basement, including the modelling of drill core geochemistry along the drill core by means of hyperspectral drill core data.

Results can be used to I) advance stratigraphic correlation of basement and cover rocks based on objective drill core mineralogy, II) map intensity of weathering of basement, and III) map mineralogical and physicochemical gradients potentially related to hydrothermal systems.



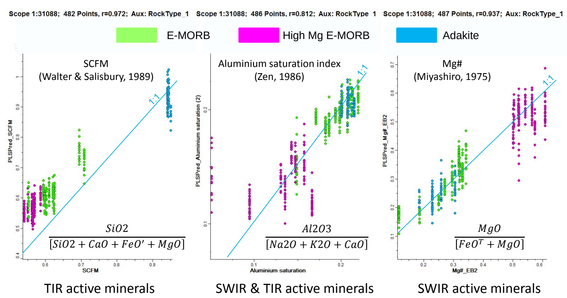
Simplified stratigraphic correlation between seven drill holes from the Haig and Forrest areas (modified after Scheib, 2014). HyLogged drill cores indicated by red arrows (blue: presented in this poster).

Recipe

1. Major and minor element XRF geochemistry was provided by GSWA
2. High-resolution RGB-imagery, visible-near infrared (390-1000nm), shortwave (1000-2500nm), and thermal infrared (6500-14500nm) reflectance spectra were acquired from drill cores using a HyLogger3 located at GSWA's drill core library in Carlisle.
3. Combined acquisition of VNIR, SWIR and TIR data allowed the characterisation of most major rock forming minerals, such as carbonates as well as hydrous and anhydrous silicates.
4. Analyses of mineral assemblages and modelling of geochemical indices was performed using The Spectral Geologist software (https://research.csiro.au/thespectralgeologist/).
5. A Partial Least Squares (PLS) regression method was applied to model geochemical indices from hyperspectral data by using GSWA's geochemical analyses as calibration samples.
6. Modelled geochemical indices allow more detailed characterisation of basement rock types.

5. PLS modelling

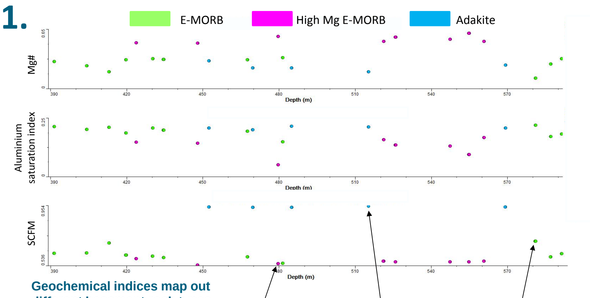
The potential for modelling geochemical indices, such as the Mg# (Mg/(Mg+Fe)) from SWIR hyperspectral data has been known since many years (e.g. Laukamp et al., 2012). For this project the potential use of SWIR and TIR data was evaluated for modelling three geochemical indices, that are commonly use to characterise basement lithologies:



TIR active minerals | SWIR & TIR active minerals | SWIR active minerals

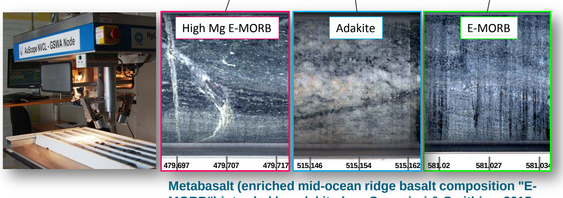
Example I: drill core MAD002

1.



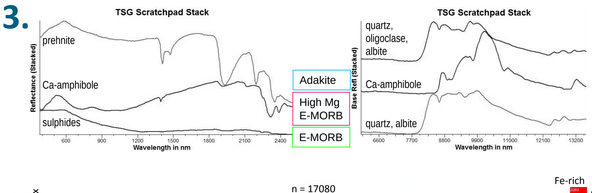
Geochemical indices map out different basement rock types

2.



Metabasalt (enriched mid-ocean ridge basalt composition "E-MORB") intruded by adakite (see Spaggiari & Smithies, 2015, for lithological and whole-rock geochemical information)

3.



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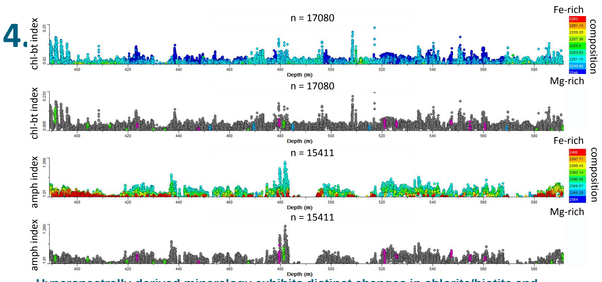
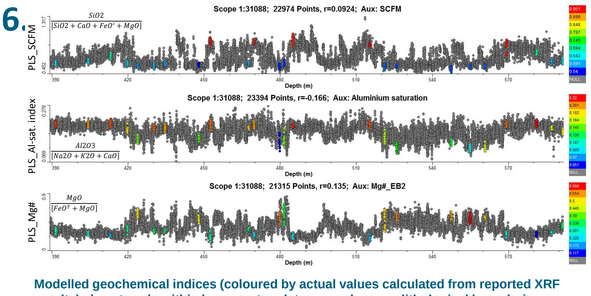


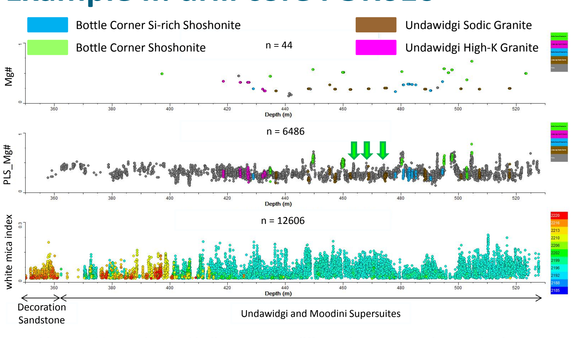
Hyperspectrally-derived mineralogy exhibits distinct changes in chlorite/biotite and amphibole abundances and their composition within metabasalts

6.



Modelled geochemical indices (coloured by actual values calculated from reported XRF results) show trends within basement rock types and across lithological boundaries

Example II: drill core FOR010



As with MAD002, geochemical indices map out different basement rock types (top). However, Mg# values modelled from hyperspectral data provide more detail, enabling the identification of additional intervals of the Bottle Corner Shoshonite (centre, green arrows). Phengitic white micas are evident in top part of basement, though compositional change suggested by hyperspectral data may be impacted by paleo-weathering (bottom).

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