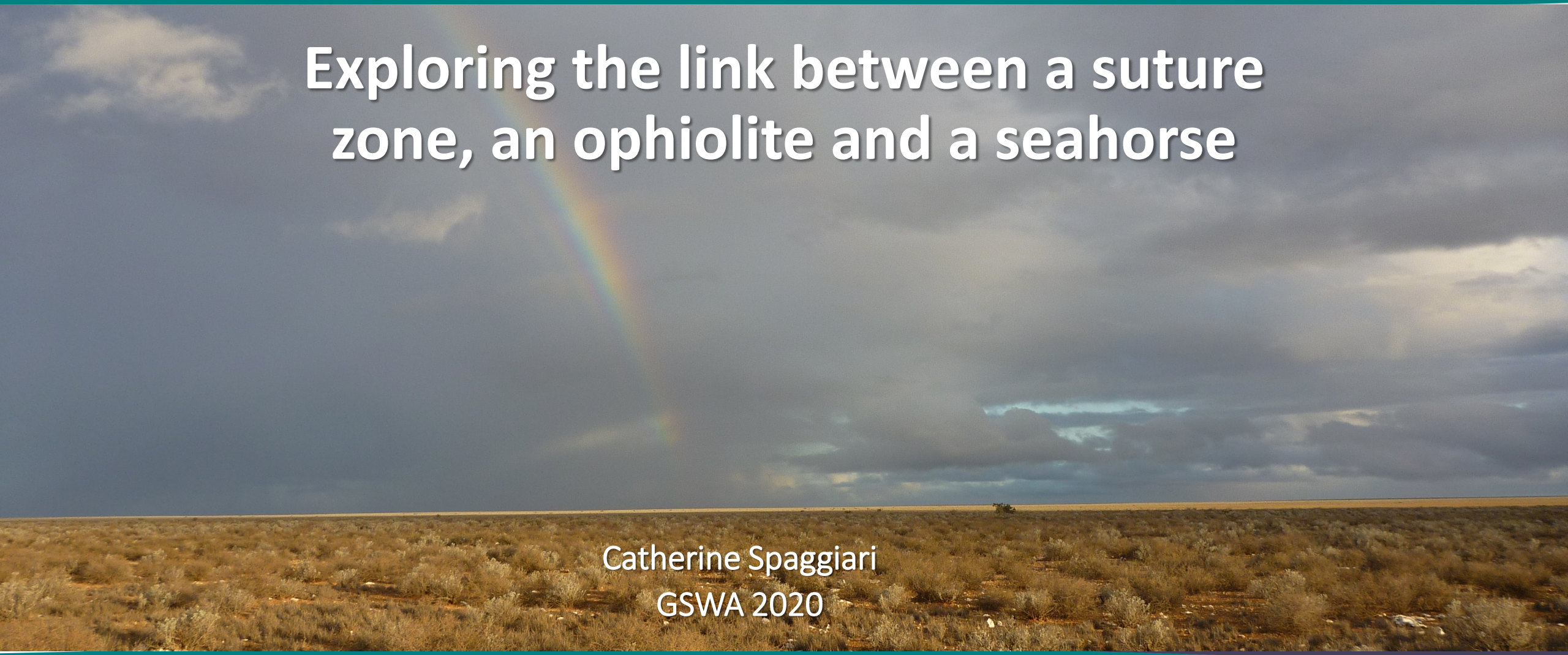
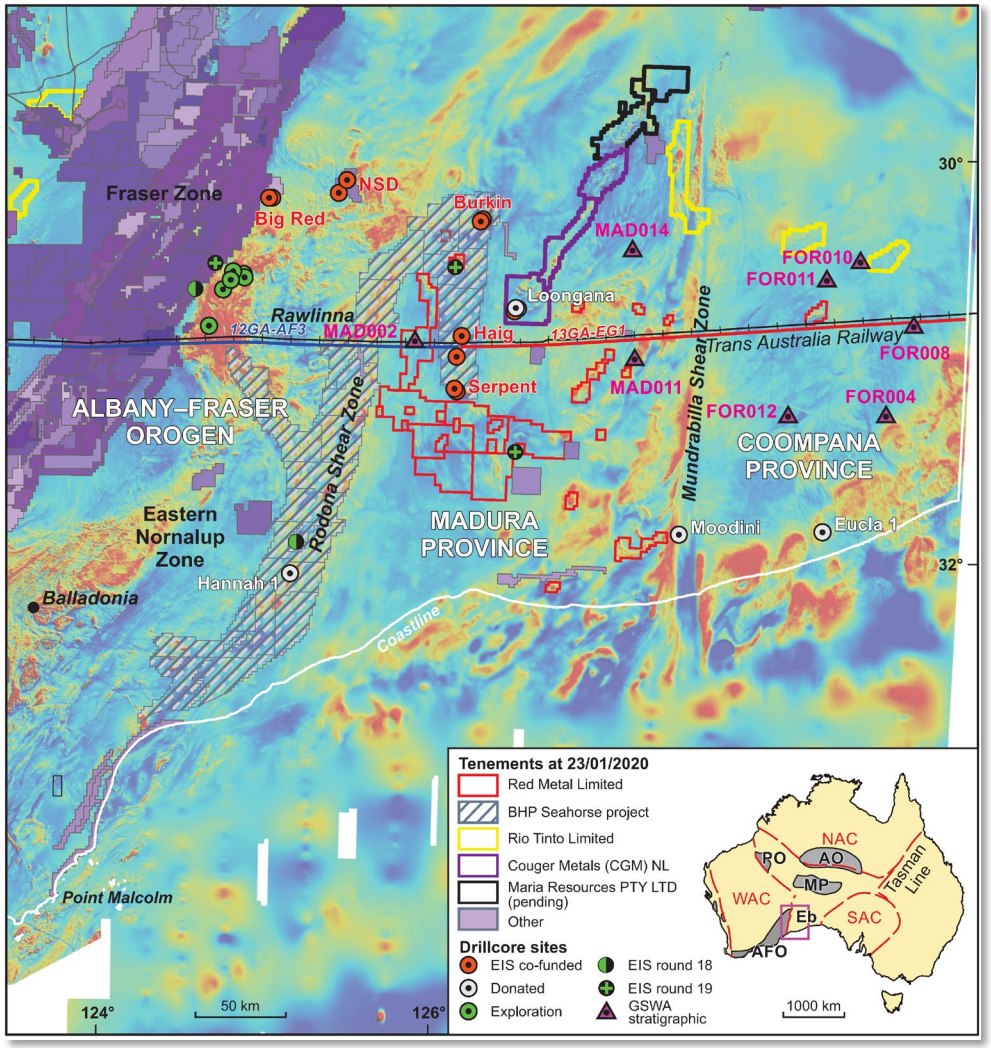
# Exploring the link between a suture zone, an ophiolite and a seahorse



Catherine Spaggiari
GSWA 2020

# Remote greenfields exploration – Eucla basement

- Between 2009 and 2014, GSWA completed a program of Exploration Incentive Scheme-funded geophysical data acquisition and stratigraphic drilling to reveal the Precambrian basement geology beneath the Nullarbor Plain
- At the time, tenements were sparse but recently the EIS investment has led to considerable new tenement uptake
- Red Metals is focussed on IOCG, Cu-Au and Ni-Cu
- The BHP Seahorse project is primarily focussed on intrusion-related Ni-Cu
- Both companies have received grants for EIS co-funded drilling

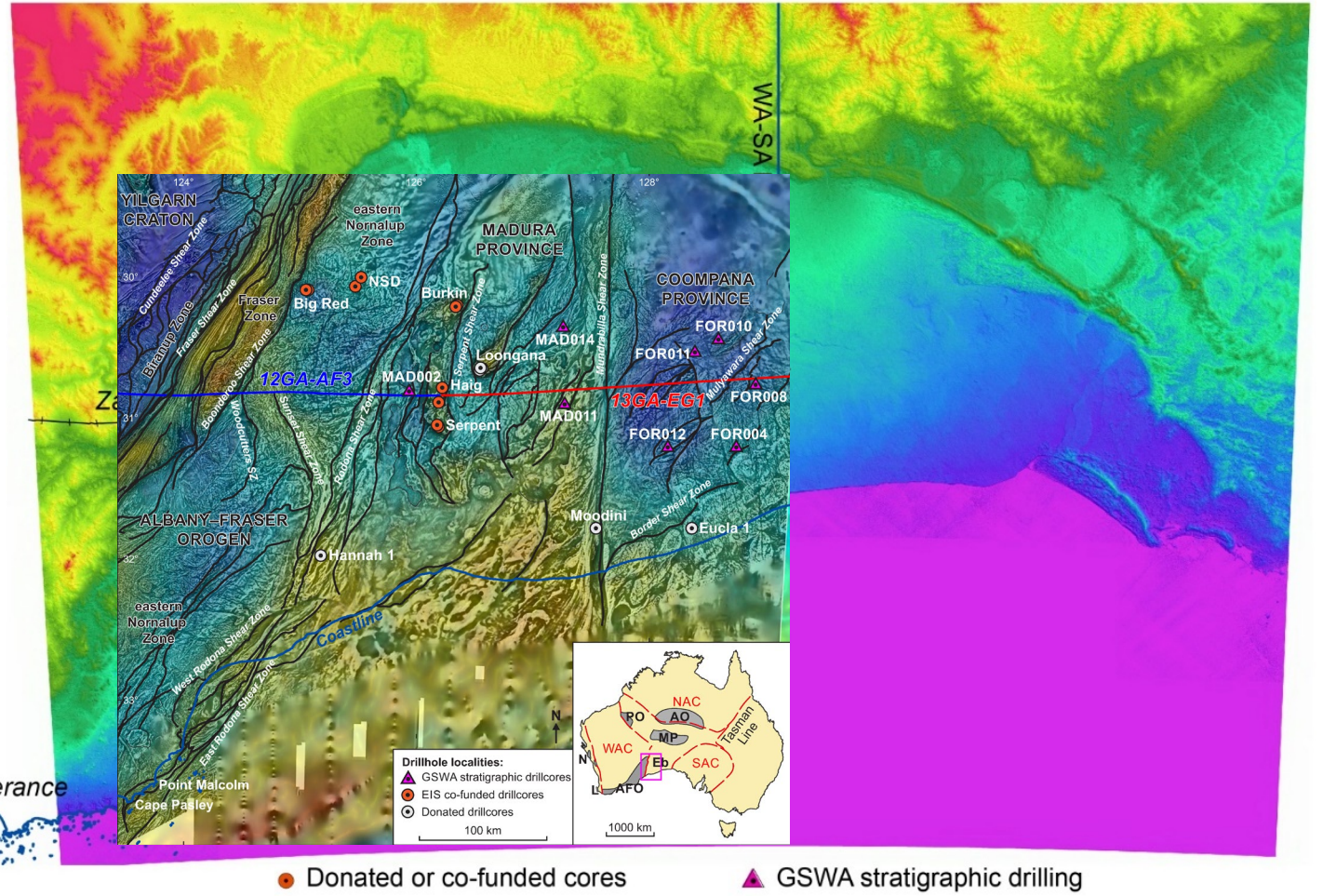



*Reduced to pole aeromagnetic image showing the location of tenements as at 23/01/2020 and site locations for drillcores, most of which are archived in the Perth Core Library.*

EXPLORATION INCENTIVE SCHEME

# The Eucla basement stratigraphic drilling program

- Eight stratigraphic diamond holes were drilled; total of 1,560 m of basement rocks
- Cost was approximately $3.5 million – with lessons learnt could reduce this
- Detailed analytical work on the drillcores and also exploration drillcores (GSWA Report 204 out soon)
- Coupled with geophysical data interpretation, the results have been province-defining and have also provided significant insight into the evolution of the Albany-Fraser Orogen
- Provides a geological framework for mineral systems analysis

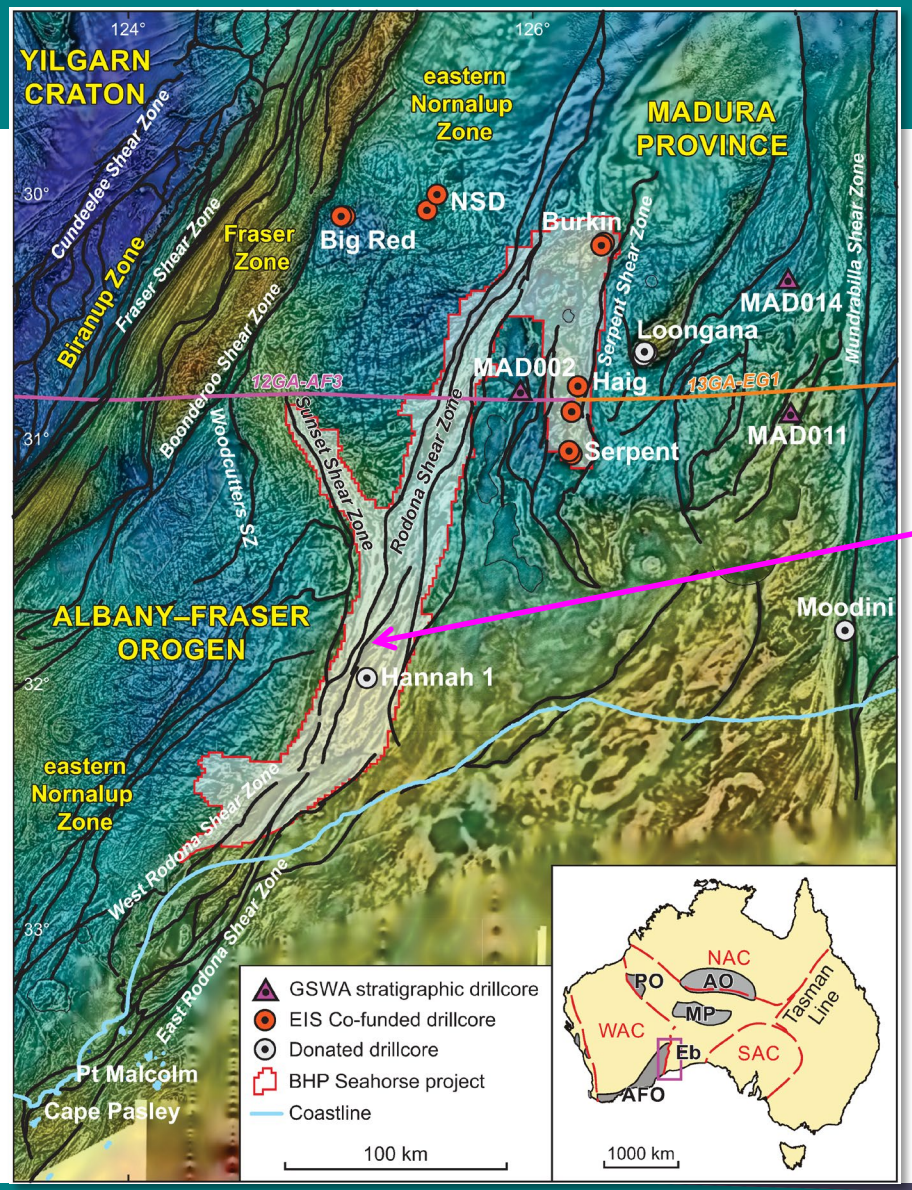



*Eucla basement drillhole locations on an SRTM image showing the Eucla Basin cover*

EXPLORATION INCENTIVE SCHEME

# BHP Seahorse project

- Covers a large tenement package in the shape of a seahorse
- Seahorse crossed by deep crustal seismic and MT lines 12GA-AF3 and 13GA-EG1 (GA, GSWA, GSSA)
- Encompasses most of the Rodona Shear Zone (suture zone)
- EIS co-funded drilling grant in Round 18 for Hedgehog prospect
- Includes the Sunset Shear Zone, which in part separates two structurally and geophysically different domains of the eastern Nornalup Zone of the Albany–Fraser Orogen




EIS Round 18; Hedgehog prospect

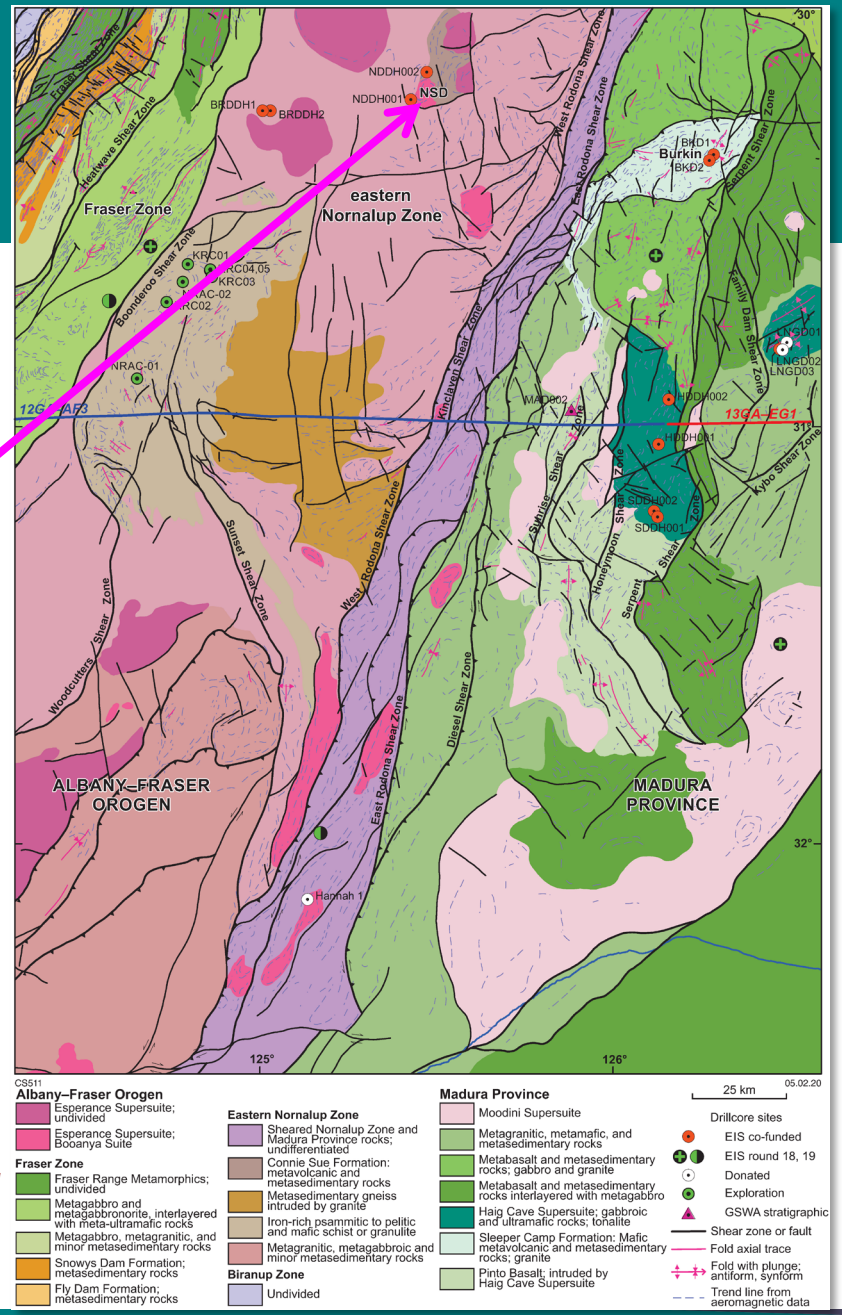
*Drape image of gravity (colour) and reduced to pole, first vertical derivative aeromagnetic data (greyscale) showing the location of the BHP Seahorse project tenement package, simplified structures, deep crustal seismic lines and site locations for drillcores*

EXPLORATION INCENTIVE SCHEME

# Northeastern Nornalup Zone - unknown

- Part of Eucla basement, under cover
- Contains the ≥ c. 1180 Ma Connie Sue Formation (NSD prospect)
- Overthrust Madura? Part of the Arid Basin?
- Structurally and geophysically different to southeastern Nornalup Zone – includes the Sunset Shear Zone (Seahorse wing)


*NSD prospect: Fe-rich metasedimentary rocks (left); calc-silicate rocks interlayered with metabasalt (top)*

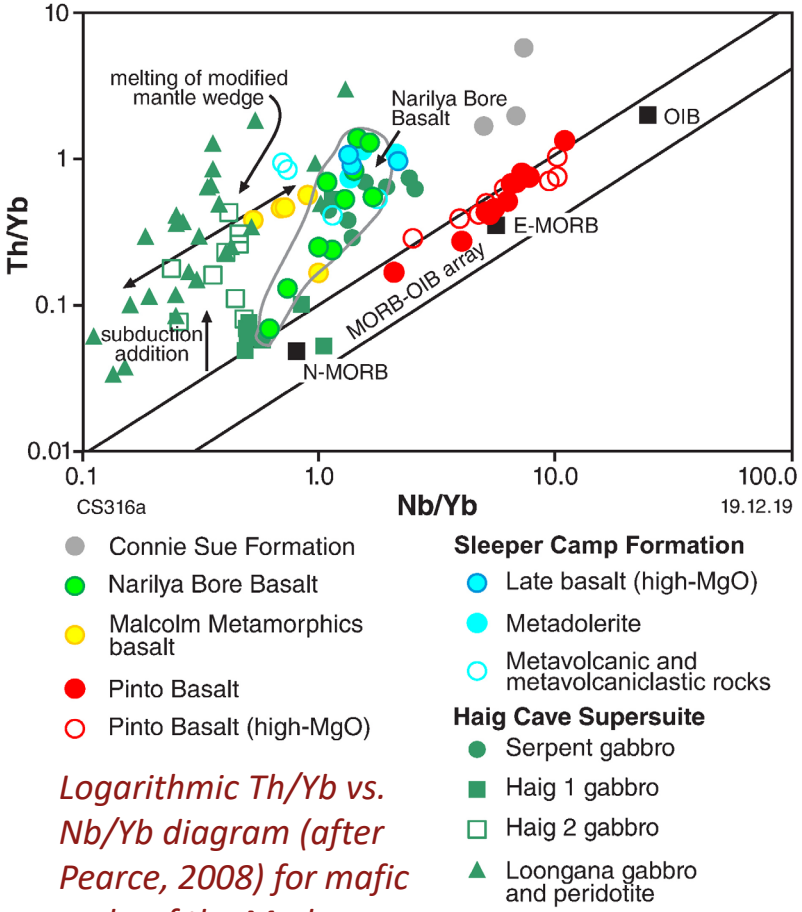



*GSWA interpreted bedrock geology map layers*

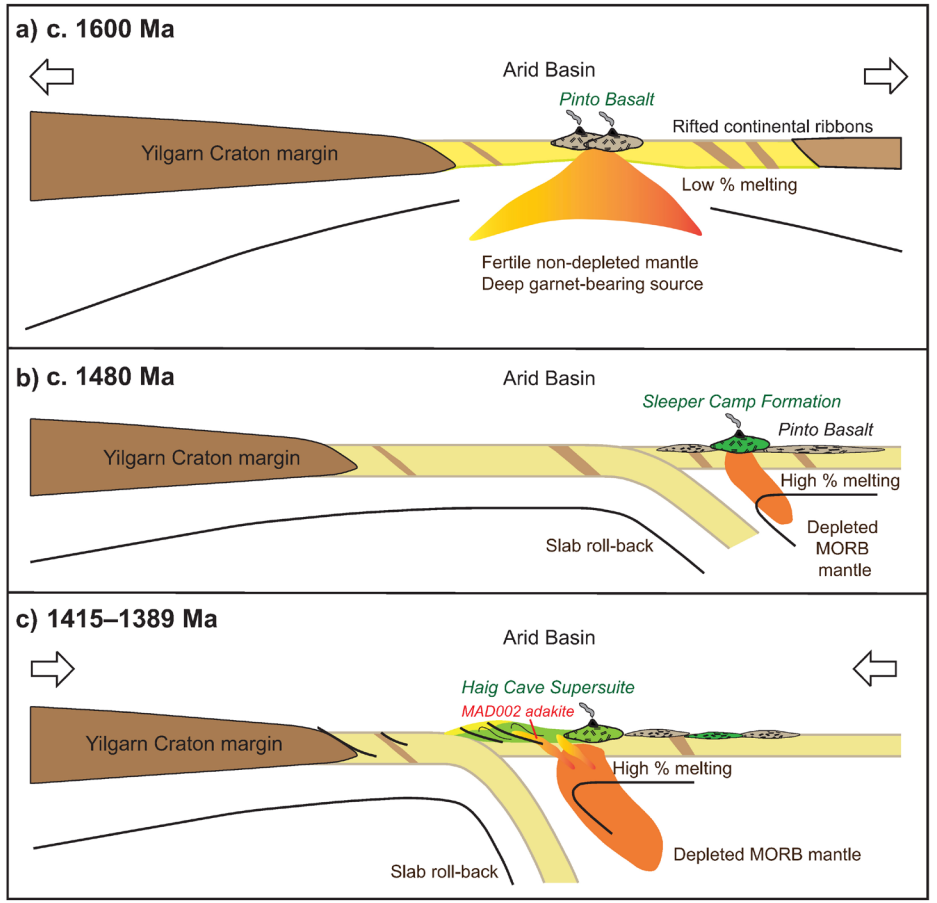
EXPLORATION INCENTIVE SCHEME

# Madura Province - rocks of oceanic affinity

- Interpreted to contain oceanic basement with remnants of hyper-extended continental crust, interleaved with 1479–1389 Ma oceanic-arc rocks
- The westernmost occurrences were accreted over the continental margin (Arubiddy Ophiolite complex)




*Logarithmic Th/Yb vs. Nb/Yb diagram (after Pearce, 2008) for mafic rocks of the Madura Province*

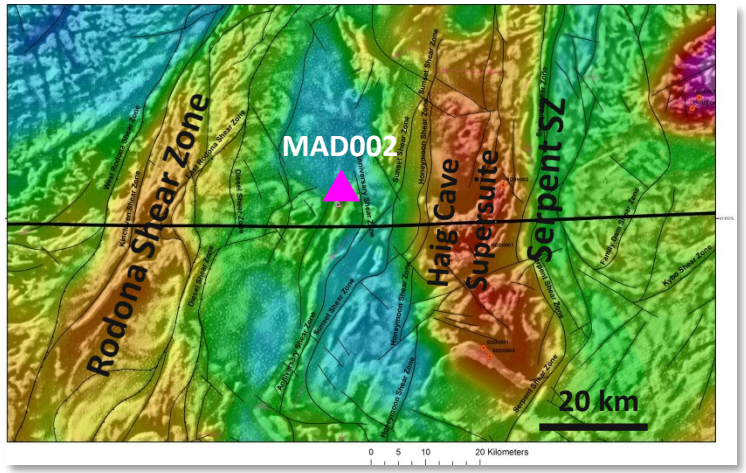



*Tectonic model. Modified from Spaggiari et al., 2018*

EXPLORATION INCENTIVE SCHEME

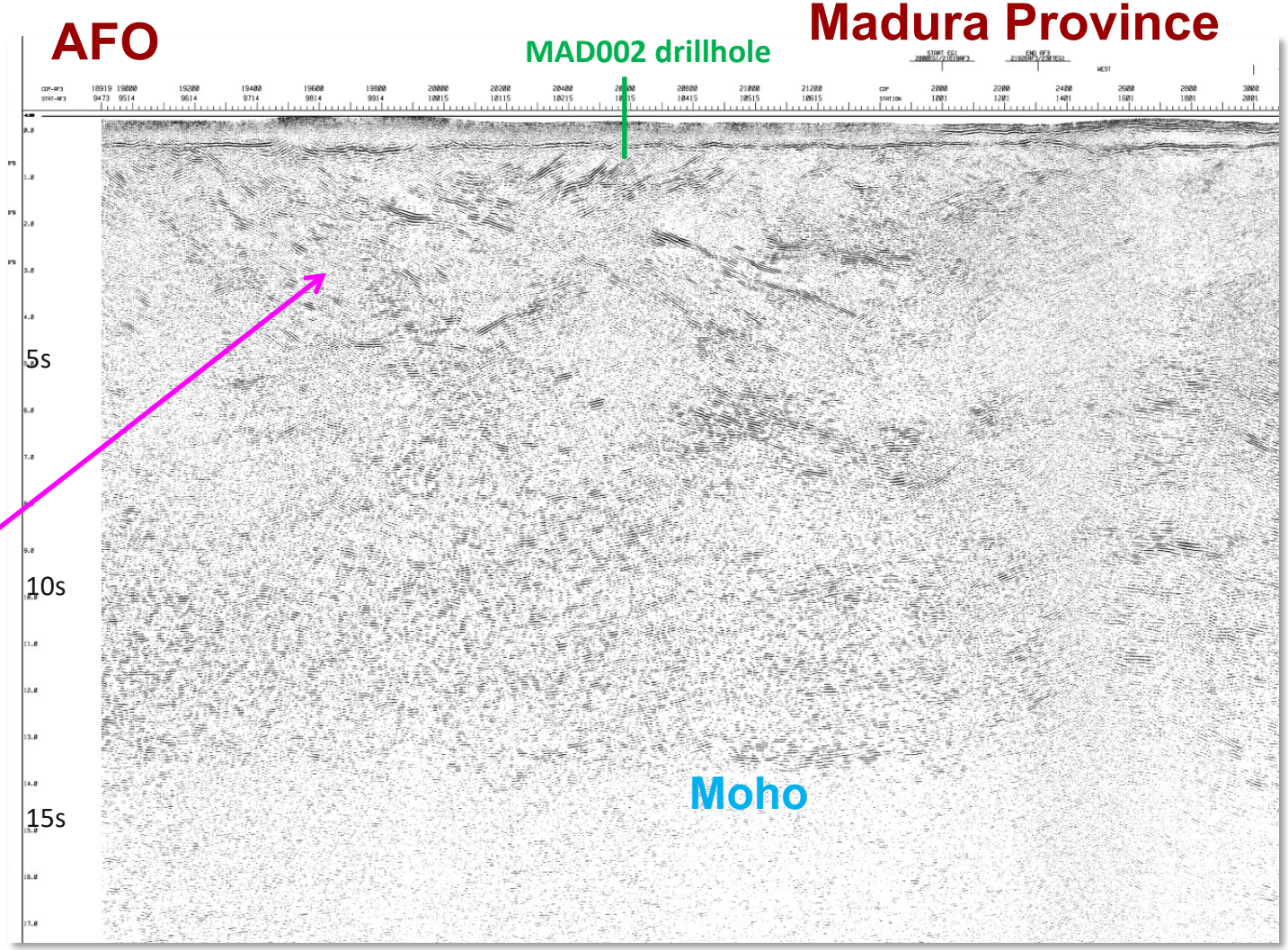
*From GSWA Report 204, coming soon*

# The suture zone: Merged section of 12GA-AF3 and 13GA-EG1 seismic lines




*Gravity (colour) with 1VD magnetics (greyscale). Seismic line shown in black.*

***Rodona Shear Zone corridor***

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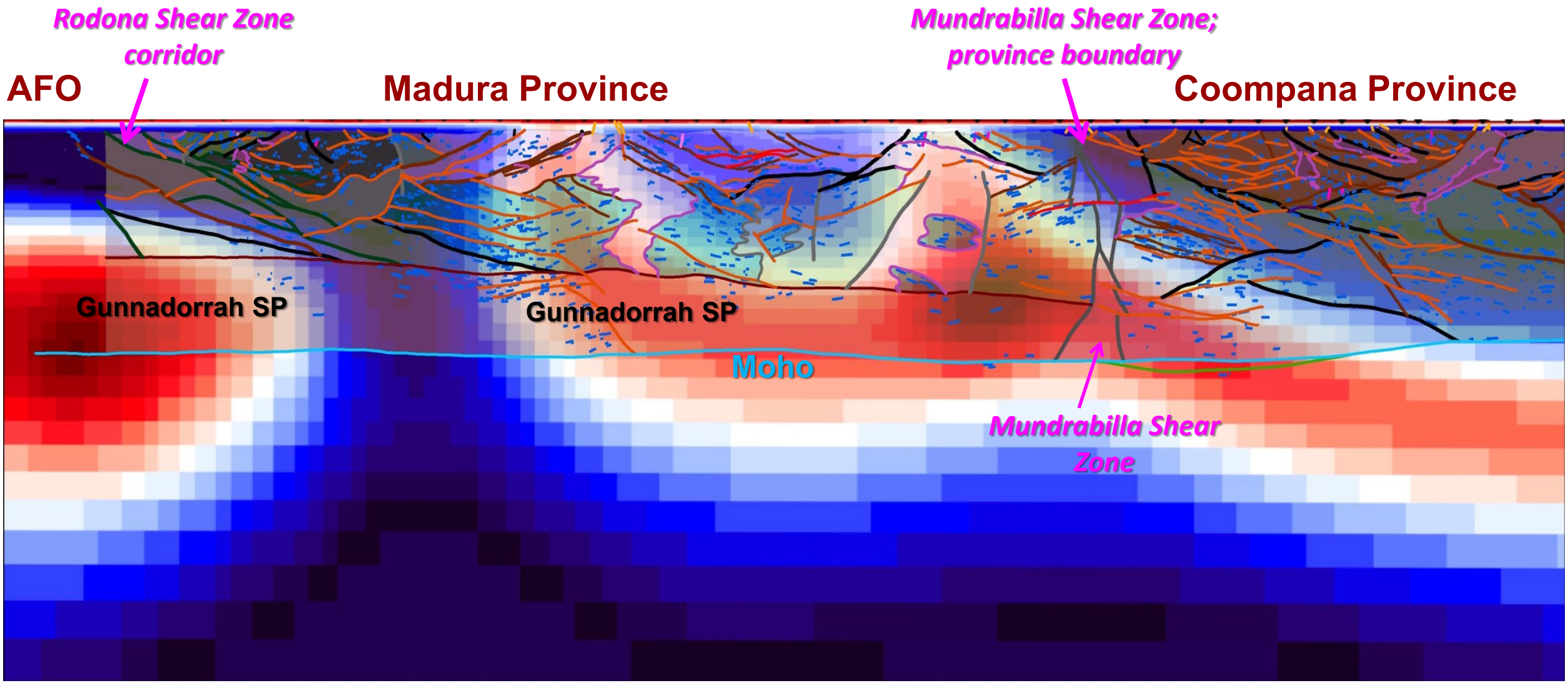
EXPLORATION INCENTIVE SCHEME

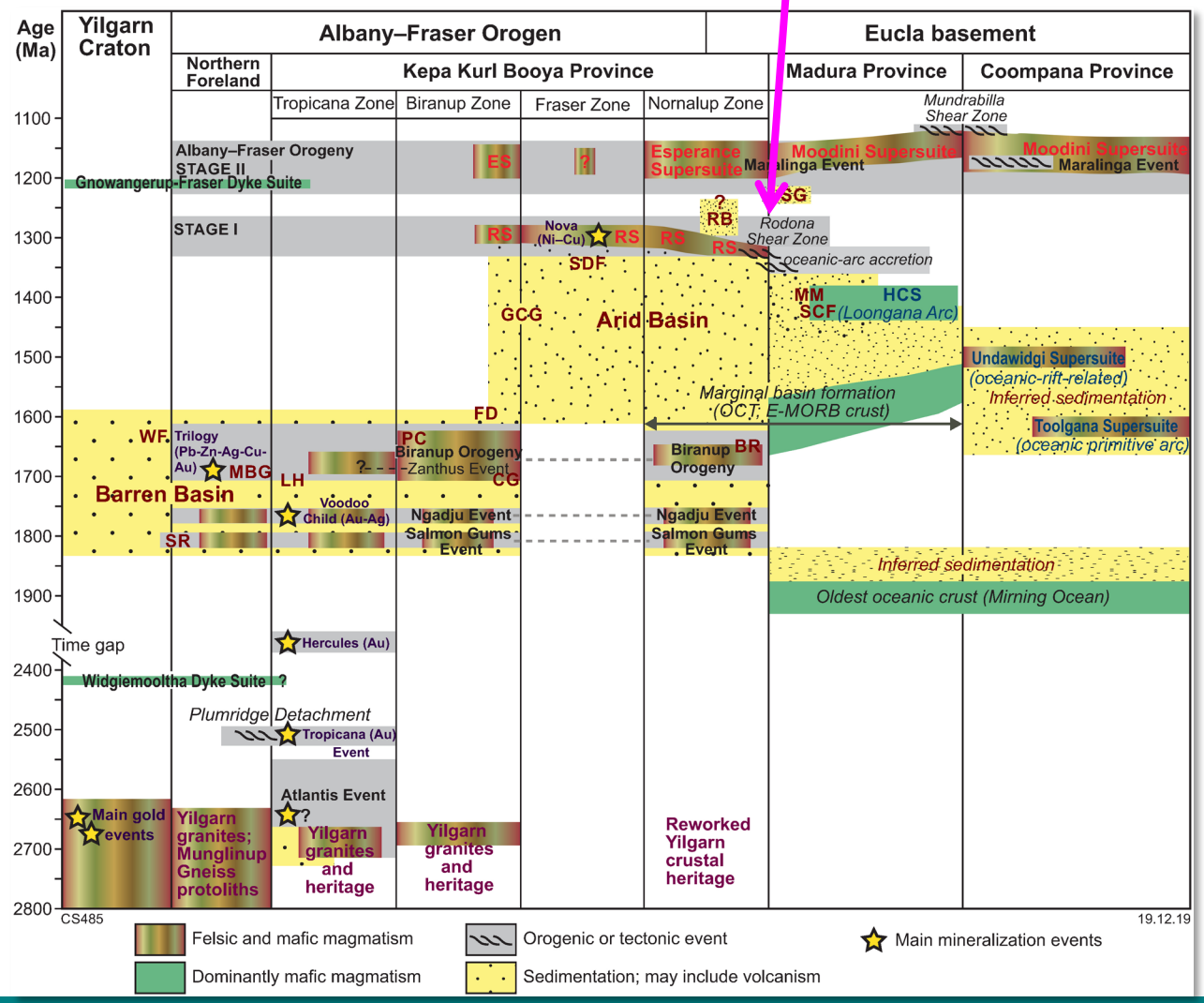
AuScope

# The suture zone: 13GA-EG1 MT line



# Key features of tectonic evolution

- Rodona Shear Zone defines the boundary between modified Yilgarn Craton (Albany-Fraser Orogen) and the Madura Province (clear in isotope and geochemical data)
- Archean-Proterozoic craton margin processes
- Transition from rift or extension-related processes to a convergent margin setting
- Development of a marginal basin – the Arid Basin
- Closure of the Arid Basin leading to inversion of major rift structures
- Orogenesis (next slide)
- **Intracratonic tectonism (Maralinga Event)**

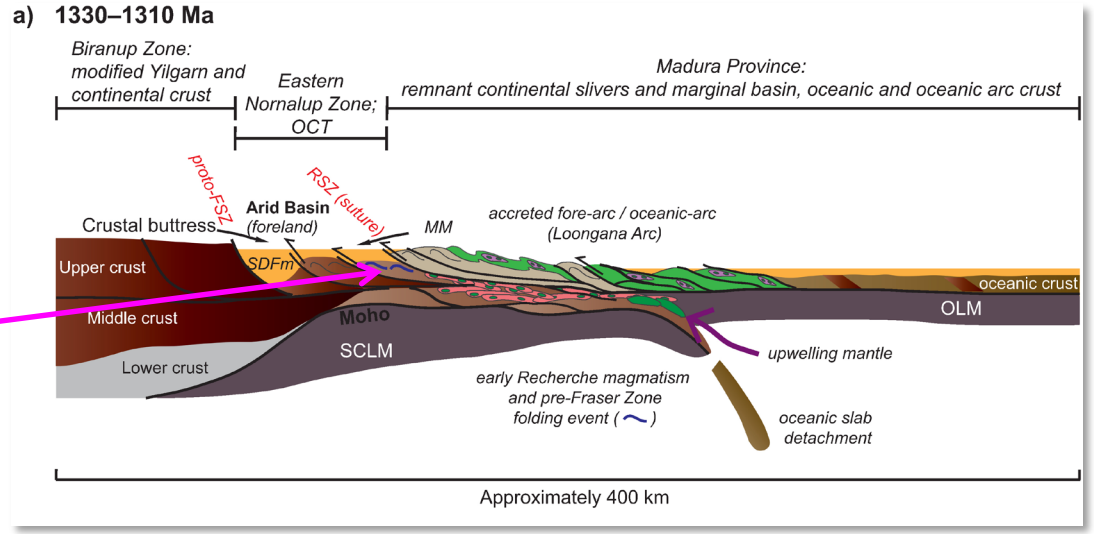


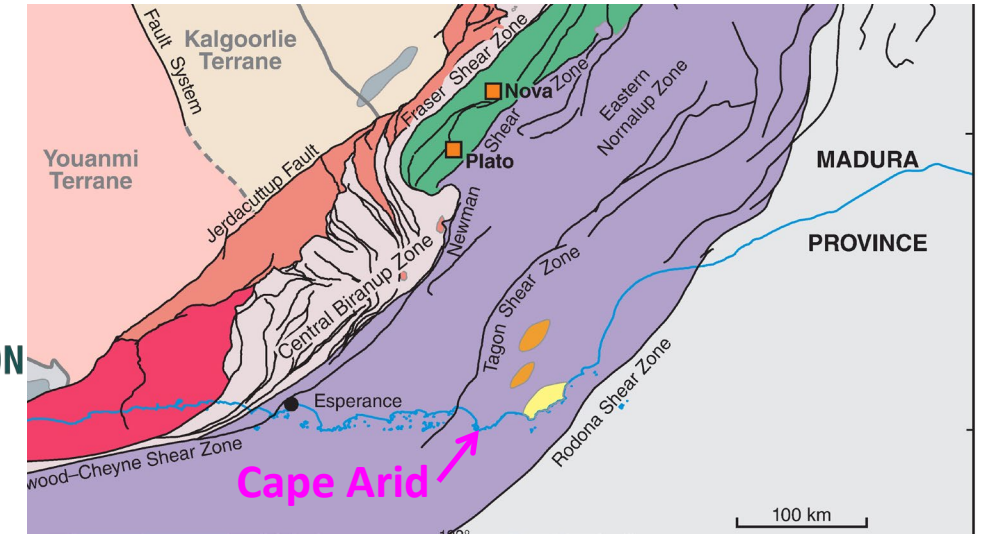

EXPLORATION INCENTIVE SCHEME

# Albany–Fraser Orogeny – Stage I

## Tectonism migrates northwest:

- New geochronology data from Cape Arid constrains a recumbent folding event to pre-date intrusion of the 1300–1280 Ma Fraser Zone gabbros to the west
- This folding event relates to accretion of the Arubiddy Ophiolite complex, leading to folding and crustal thickening below the evolving Rodona Shear Zone
- Smithies et al. (2015; Report 150) showed 1330-1280 Ma Recherche Supersuite magmatism migrated northwest, culminating with Ni–Cu-bearing Fraser Zone intrusions




EXPLORATION INCENTIVE SCHEME

**Folded granite gneiss dated at 1324 ± 7 Ma (GSWA 194865; igneous crystallization)**

**Crosscutting granite dyke dated at 1318 ± 6 Ma (GSWA 194864)**

# Ni-Cu potential - linking the Fraser Zone and the Rodona Shear Zone

## Albany–Fraser Orogeny – Stage I

- The Rodona Shear Zone trends parallel to the Fraser Zone, which is highly prospective for mafic intrusion-hosted Ni–Cu deposits
- Like the Rodona Shear Zone, the Fraser Zone is bound by crustal-scale structures (linked Fraser–Harris Shear Zone; see poster 'Multi-scale structural analysis of the Fraser Shear Zone')
- Did the Rodona Shear Zone also channel Ni–Cu-bearing mafic magmas?
- What else might it channel?