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Geospatial ML Challenges

A prospectivity analysis example

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Outline

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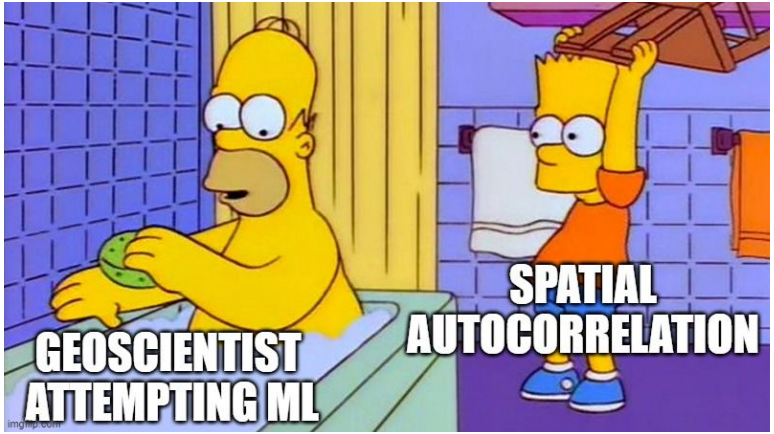
1. Study Area
2. Tasmanian tin-tungsten deposits
3. Mineral prospectivity mapping workflow
4. Accessing the notebook & data



Schedule:

www.softwareunderground.org/transform

Slack:

www.softwareunderground.org/slack

Tasmanian Tin-Tungsten Deposits

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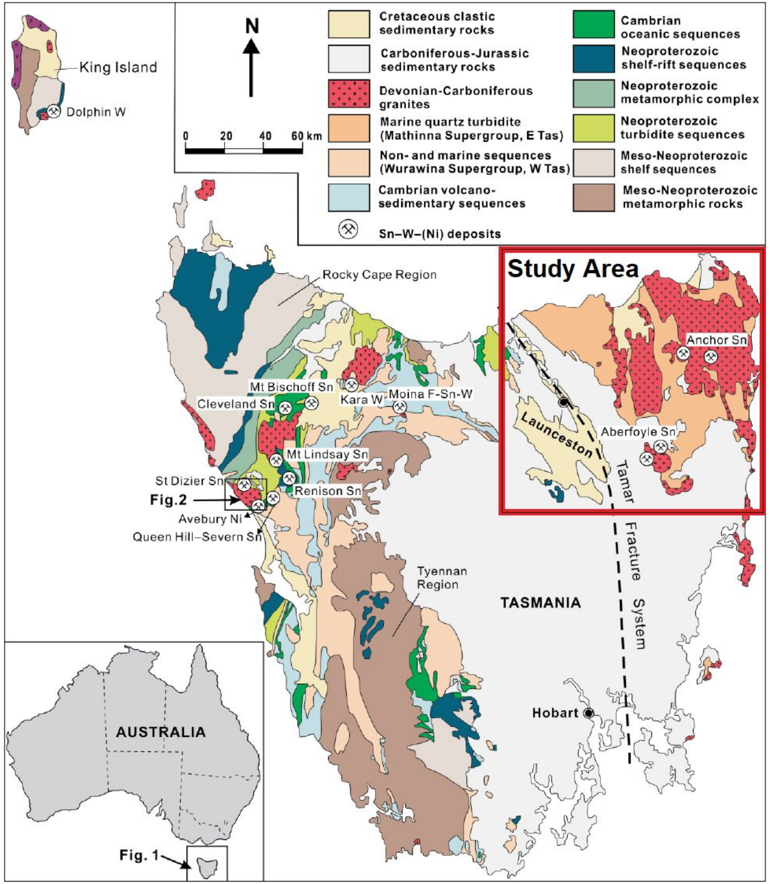
- Tin-tungsten deposits in Tasmania are associated with extensive granites that intruded East Gondwana during orogenesis in the Devonian
- Renison Sn skarn only currently operating mine
  - >100 years operation
  - ~3% of world production in 2017
- Study area focuses on northeastern Tasmania
  - Good airborne magnetic and radiometric coverage
  - Good gravity coverage
  - Simple geology
  - Its nice



Source: [Hong et al. (2019)]

Tasmanian Tin-Tungsten Deposits

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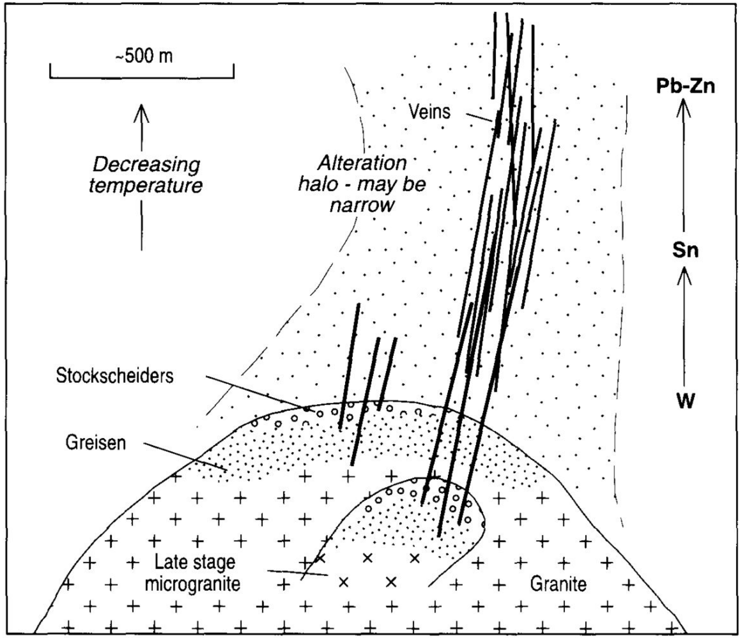
- Tin-tungsten deposits associated with upper parts of evolved Devonian granite plutons where fluids from cooling granites have ponded and/or concentrated
- Geophysical characteristics of the mineral system
    - Upper parts of low density granite bodies manifest as gravity lows
    - Low Fe-Ti oxide evolved granites tend to be magnetically 'quiet'
    - When exposed at surface, evolved prospective granites will give rise to strong radiometric responses due to high K, U and Th content



Source: Blevin (1998)

Mineral Prospectivity Mapping

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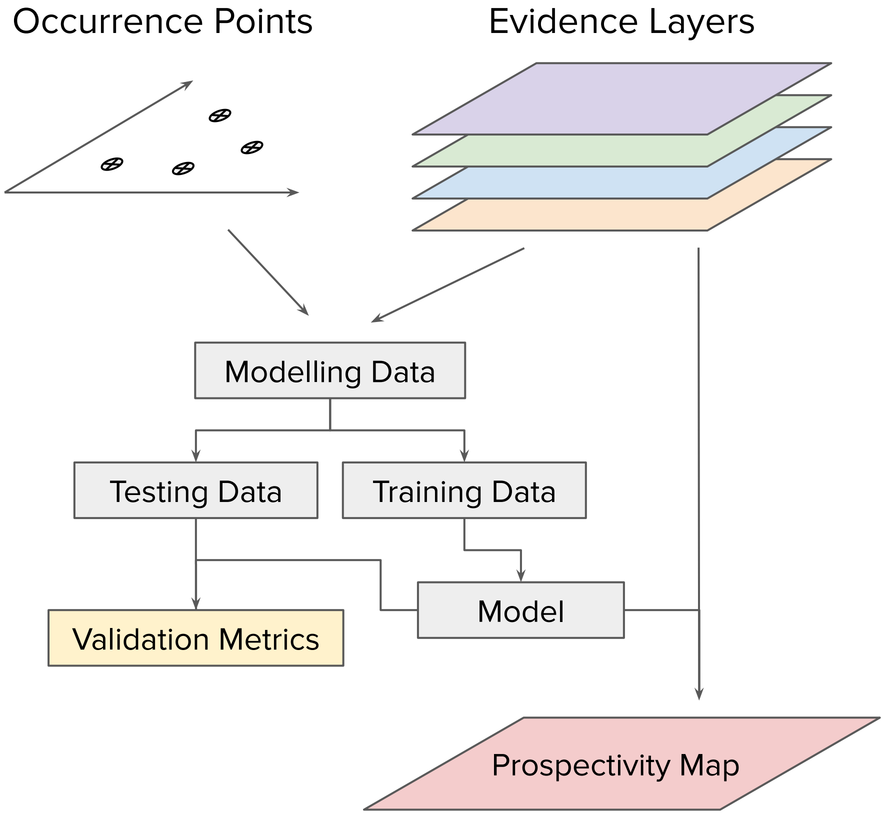
- Mineral prospectivity is a function of geological, geochemical and geophysical information quantified in maps or ‘evidence layers’
- Goal is to approximate this function with a statistical model - machine learning is well suited to this
- Use sparse mineral occurrences to derive modelling data
- Prospectivity map generated by applying the model to all evidence layers



Notebook Access & Interesting Reading

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Code, links to data and setup instructions all hosted on tutorial github page

https://github.com/Solve-Geosolutions/transform_2022

Some interesting reading:

Importance of spatial predictor variable selection in machine learning applications - Moving from data reproduction to spatial prediction - Meyer, 2019

Spatial validation reveals poor predictive performance of large-scale ecological mapping models - Ploton et al, 2020

Spatial cross-validation is not the right way to evaluate map accuracy - Wadoux et al, 2021

Predicting into unknown space? Estimating the area of applicability of spatial prediction models - Meyer, 2020

Leaky data in geoscience prediction - Daniel Coutts, Blog post, 2021

References

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Blevin, P. (1998). Palaeozoic tin tungsten deposits in eastern Australia. *AGSO JOURNAL OF AUSTRALIAN GEOLOGY AND GEOPHYSICS*, *17*, 75-80.

Hong, W., Cooke, D. R., Zhang, L., Fox, N., & Thompson, J. (2019). Cathodoluminescence features, trace elements, and oxygen isotopes of quartz in unidirectional solidification textures from the Sn-mineralized Heemskirk Granite, western Tasmania. American Mineralogist: Journal of Earth and Planetary Materials, 104(1), 100-117.