Paleovalley aquifer identification with deep learning models

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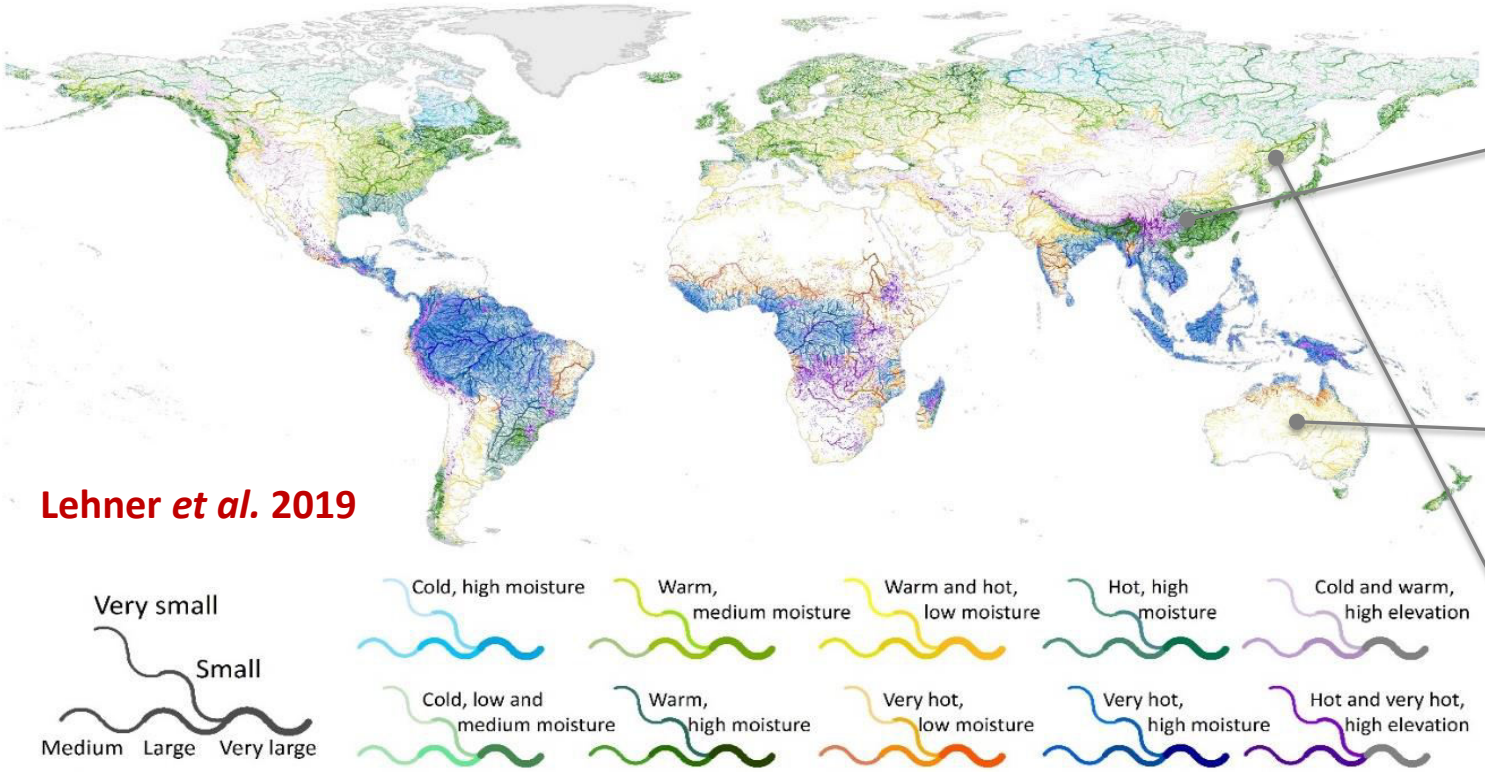
Beijing · China

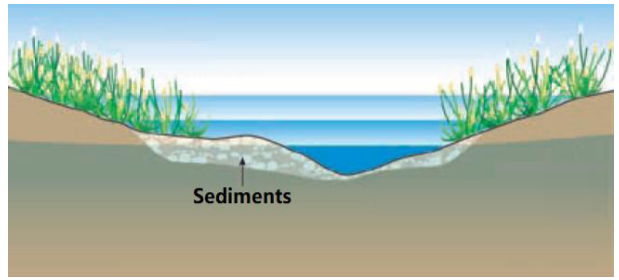
1 Importance & challenge

2 Method & application

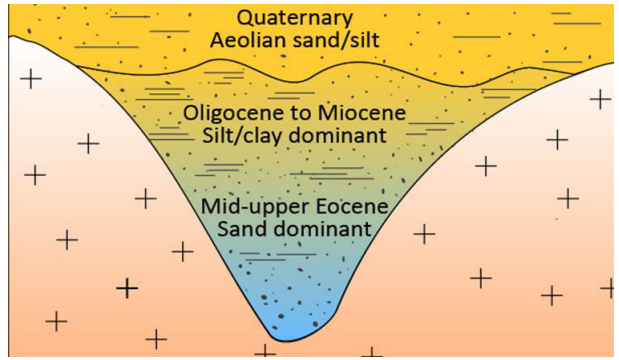
3 Conclusion & Outlook

1. Importance & Challenge

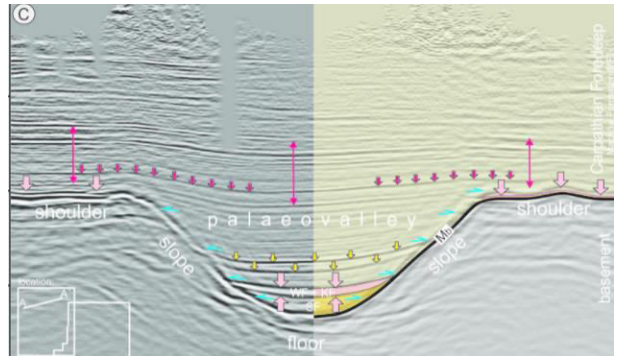




fully connected to modern river



weakly connected to modern river

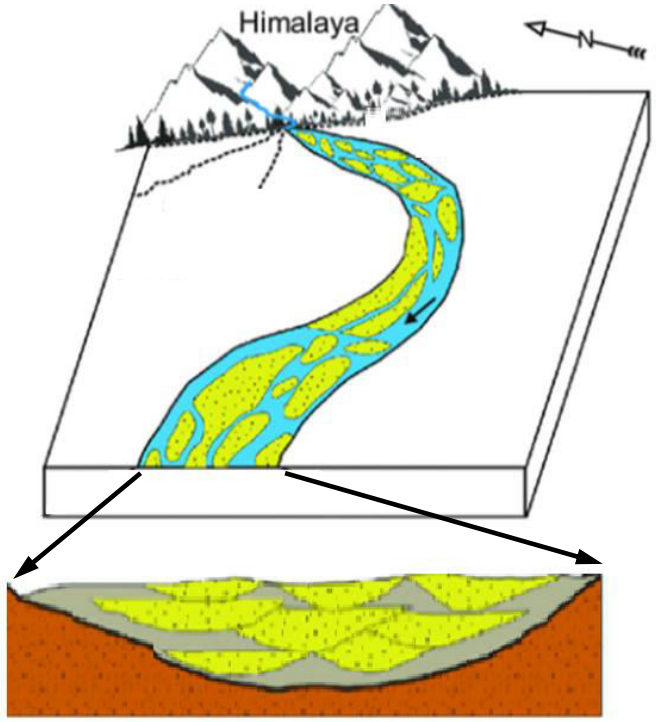


unconnected to modern river

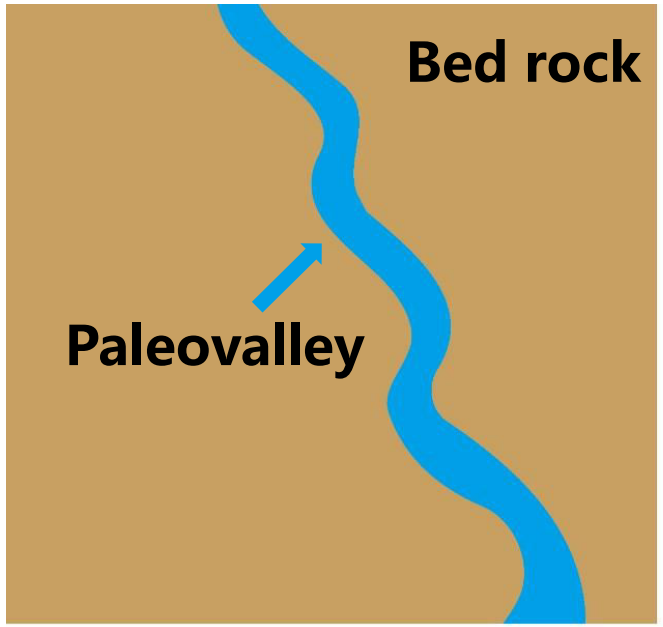
Paleovalley aquifer:

- Regulating >60% portable groundwater distribution
- Storing >40% uranium resources (i.e. sandstone-type uranium)
- Avenue of critical elements transport and exchange

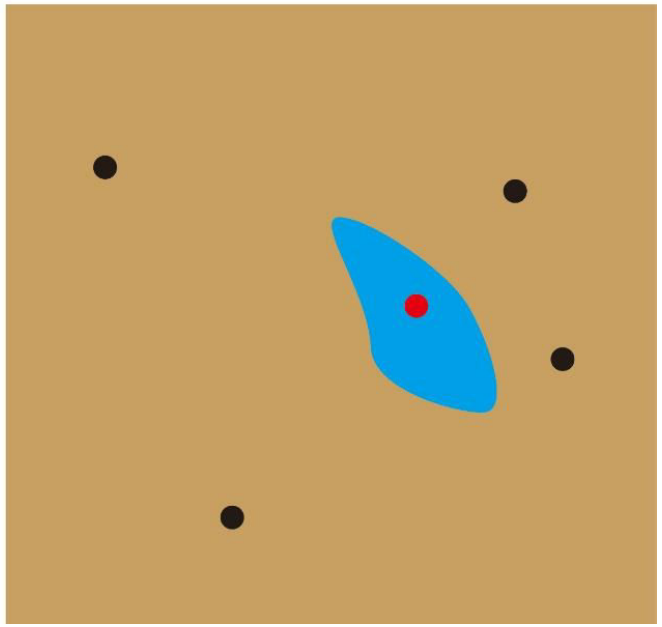
1. Importance & Challenge



Plan view and profile of paleovalley



Real status

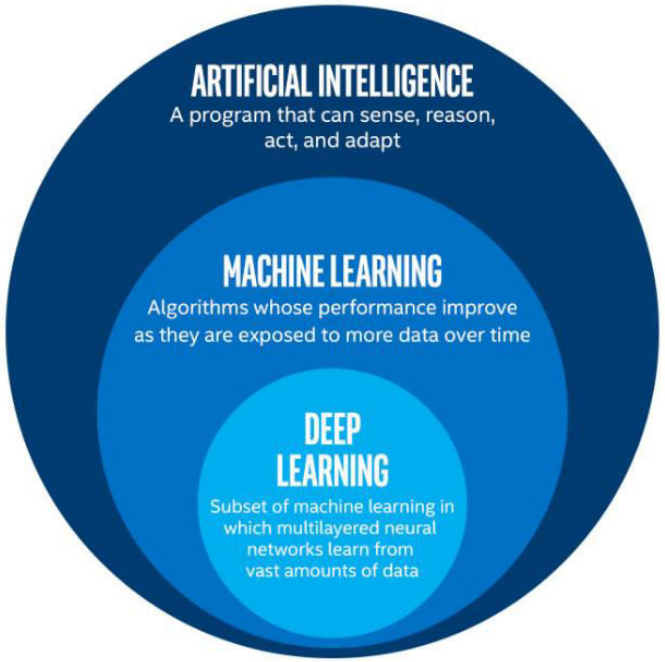


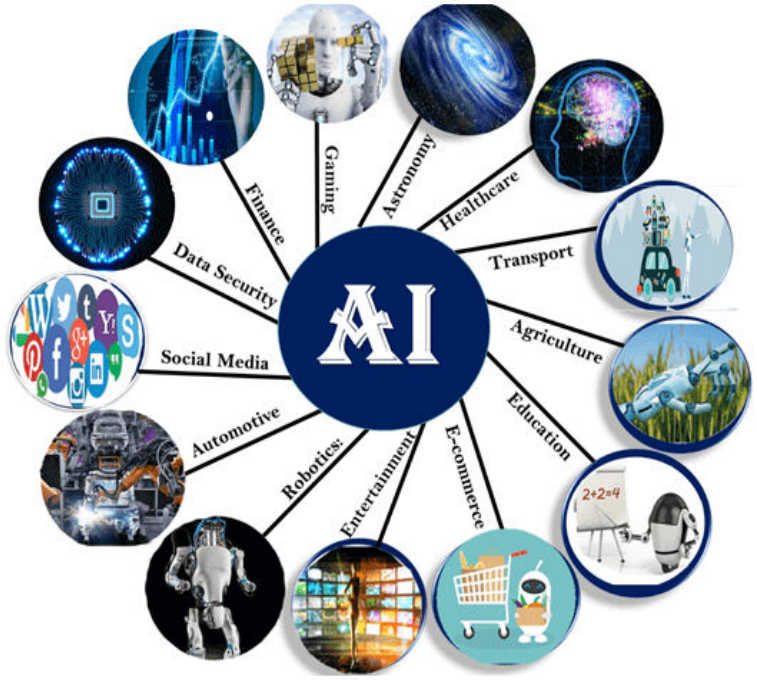
Simulated case

Non-Gaussian and connective feature; traditional method with few data support failed

Multi-supportive Data, Innovative Techniques

1. Importance & Challenge

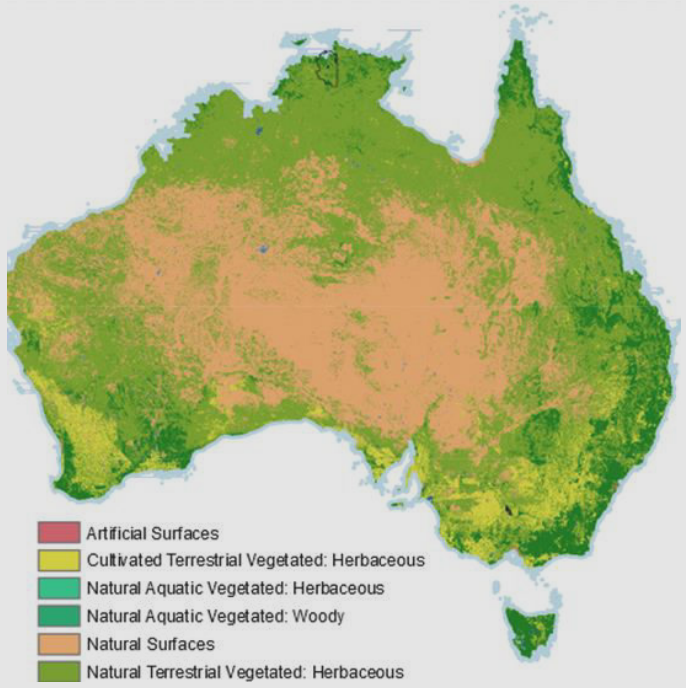




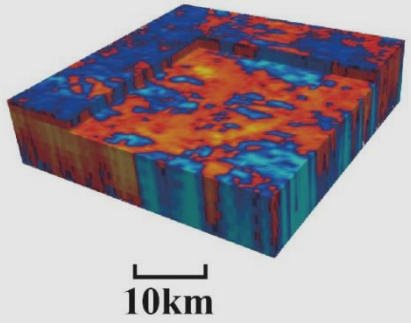
Explosive data ››› **Artificial intelligence** ››› **Wide application**

Data & AI: Providing rare opportunity for subsurface imaging

1. Importance & Challenge

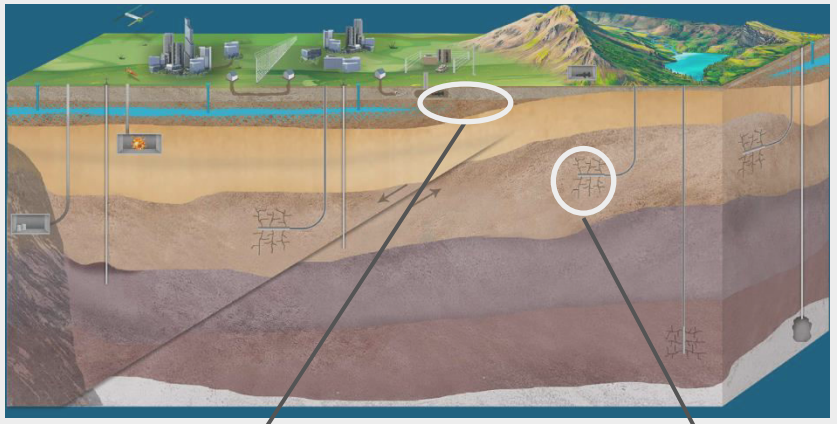


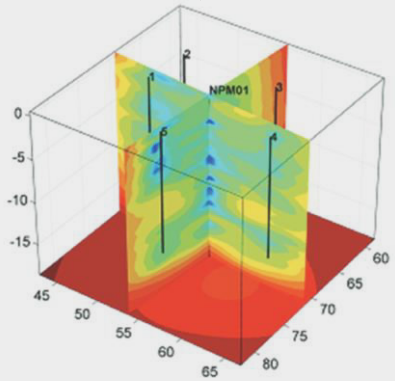
AI

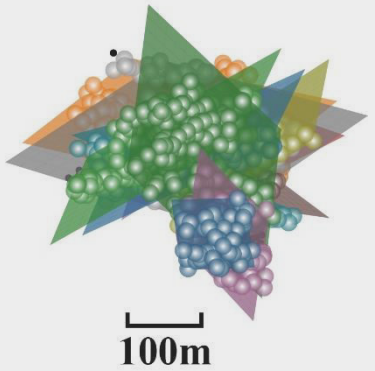


Paleovalley identification

Geological structure imaging

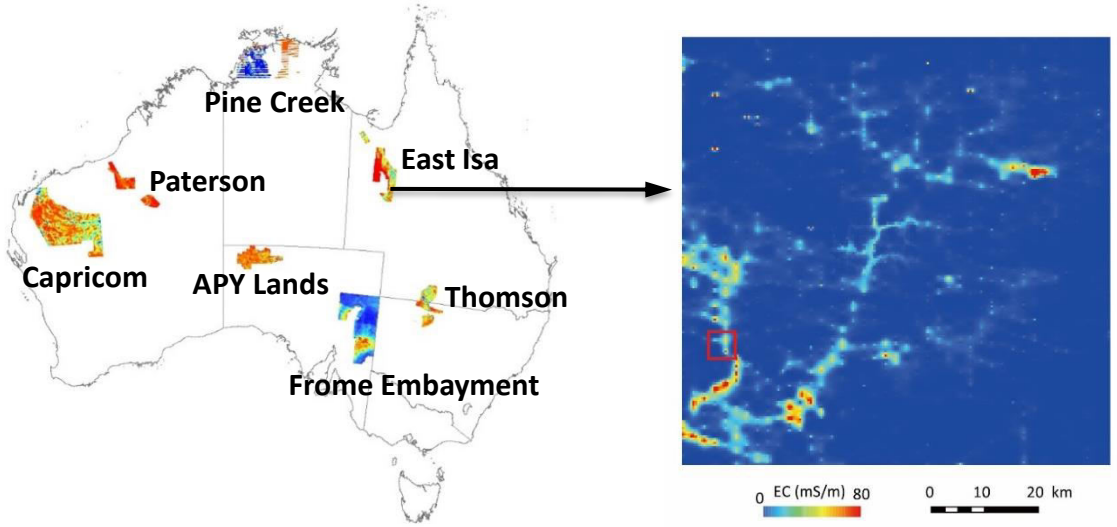




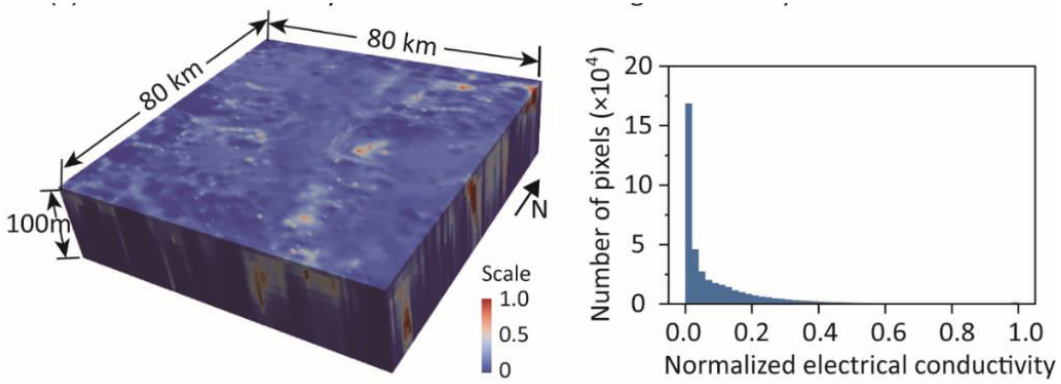


Permeability and fracture characterization

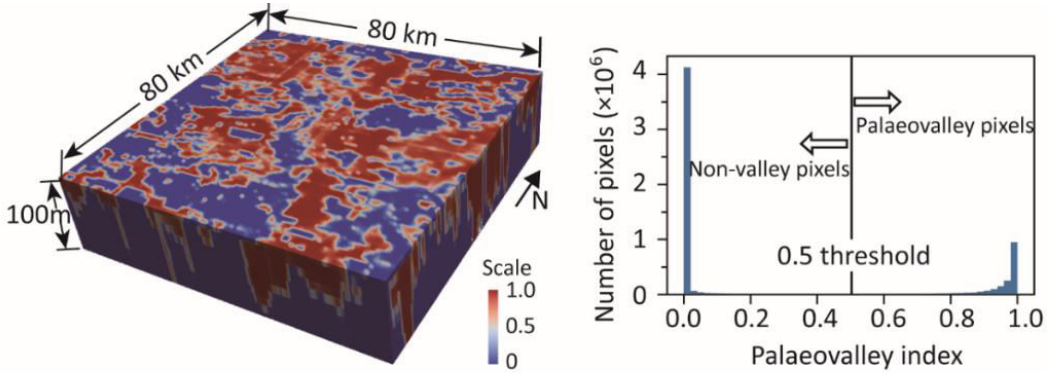
2. Method & application



Airborne electromagnetic survey (AEM)

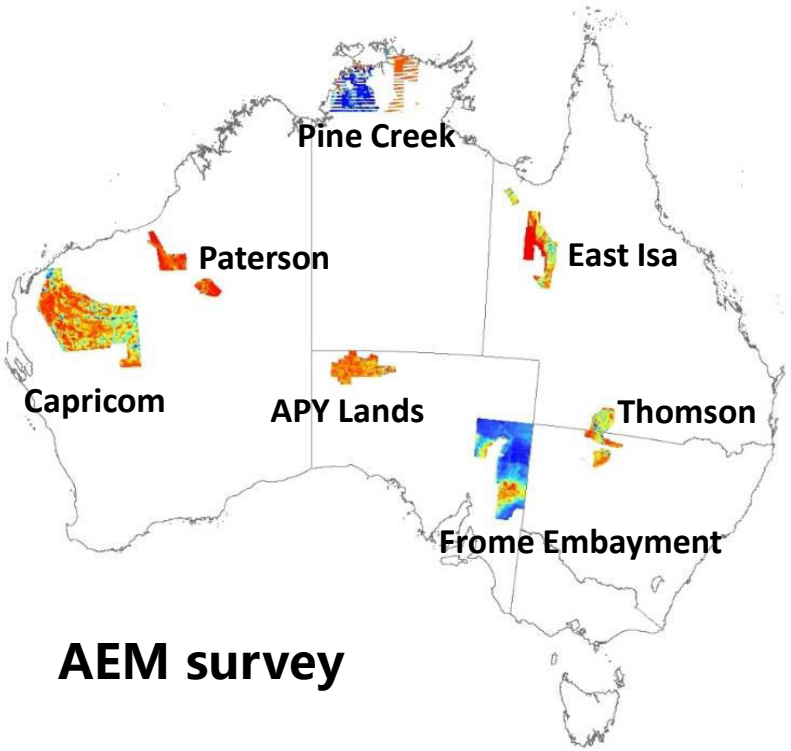


Electrical conductivity



Paleovalley index

2. Method & application



AEM survey

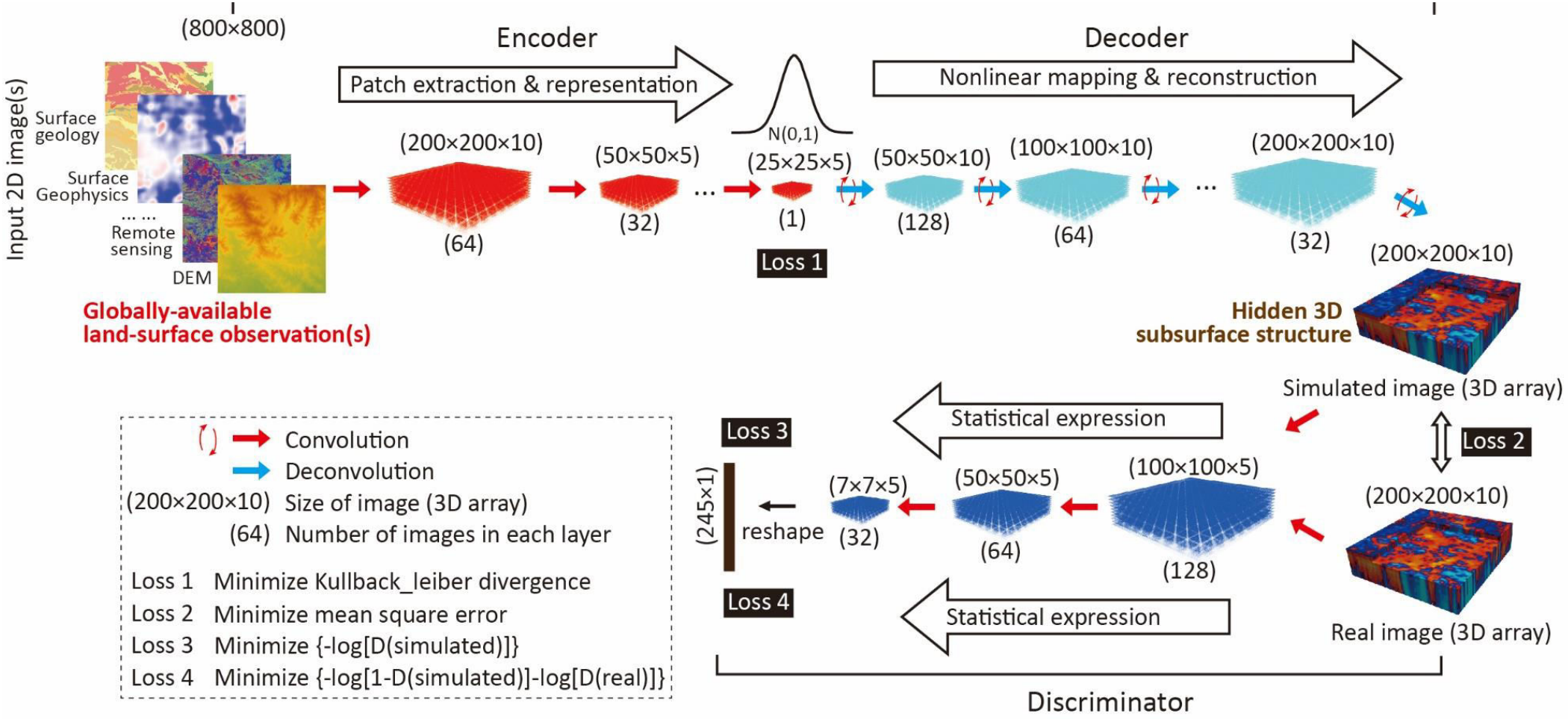
DATA IMBALANCE

Deserts in Australia

Sub3DNet：A deep learning model for subsurface imaging, by data mining and transferring

Data-rich region ⟶ Data-poor region

2. Method & application



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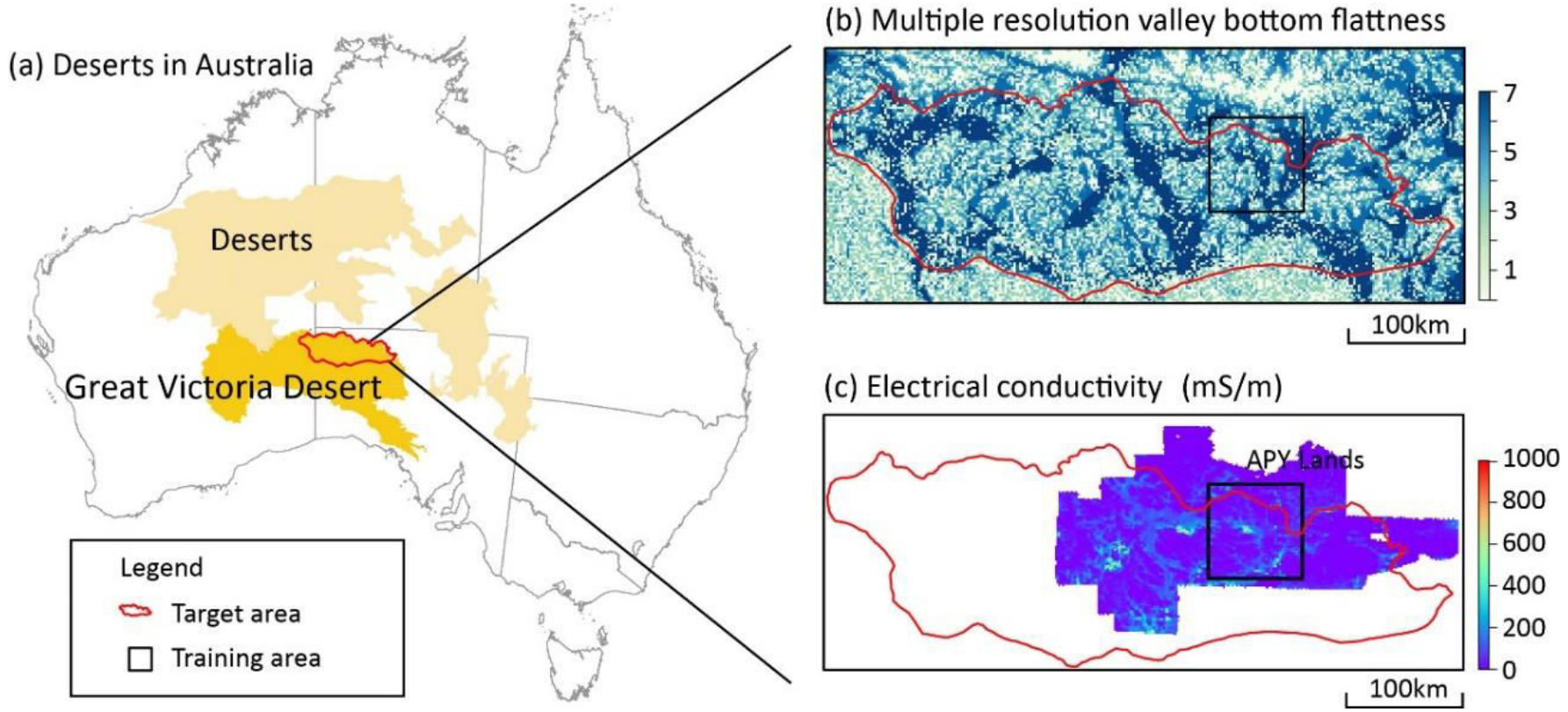
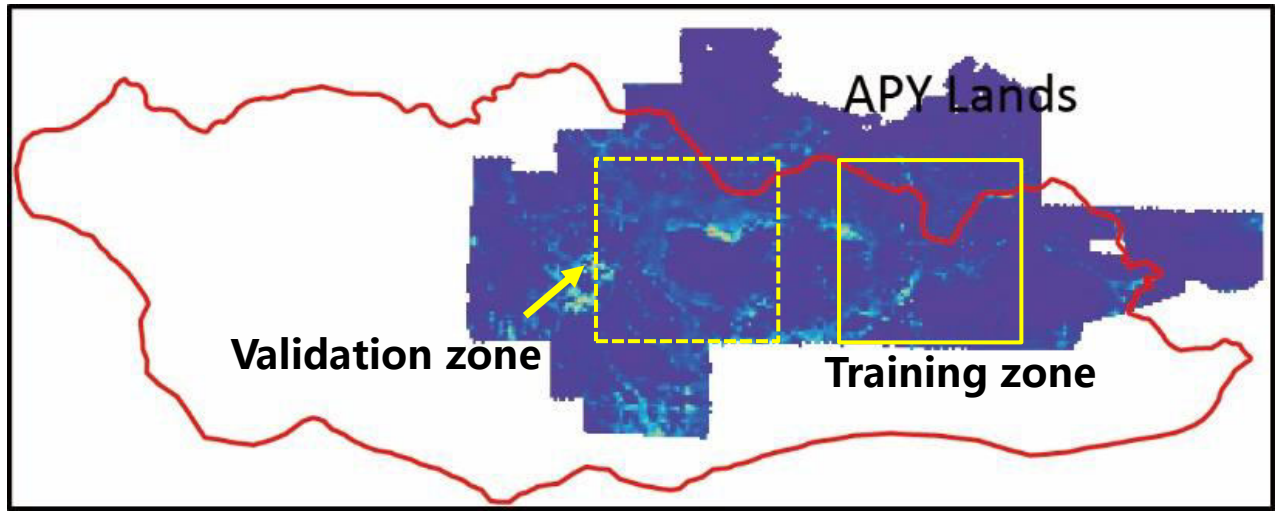


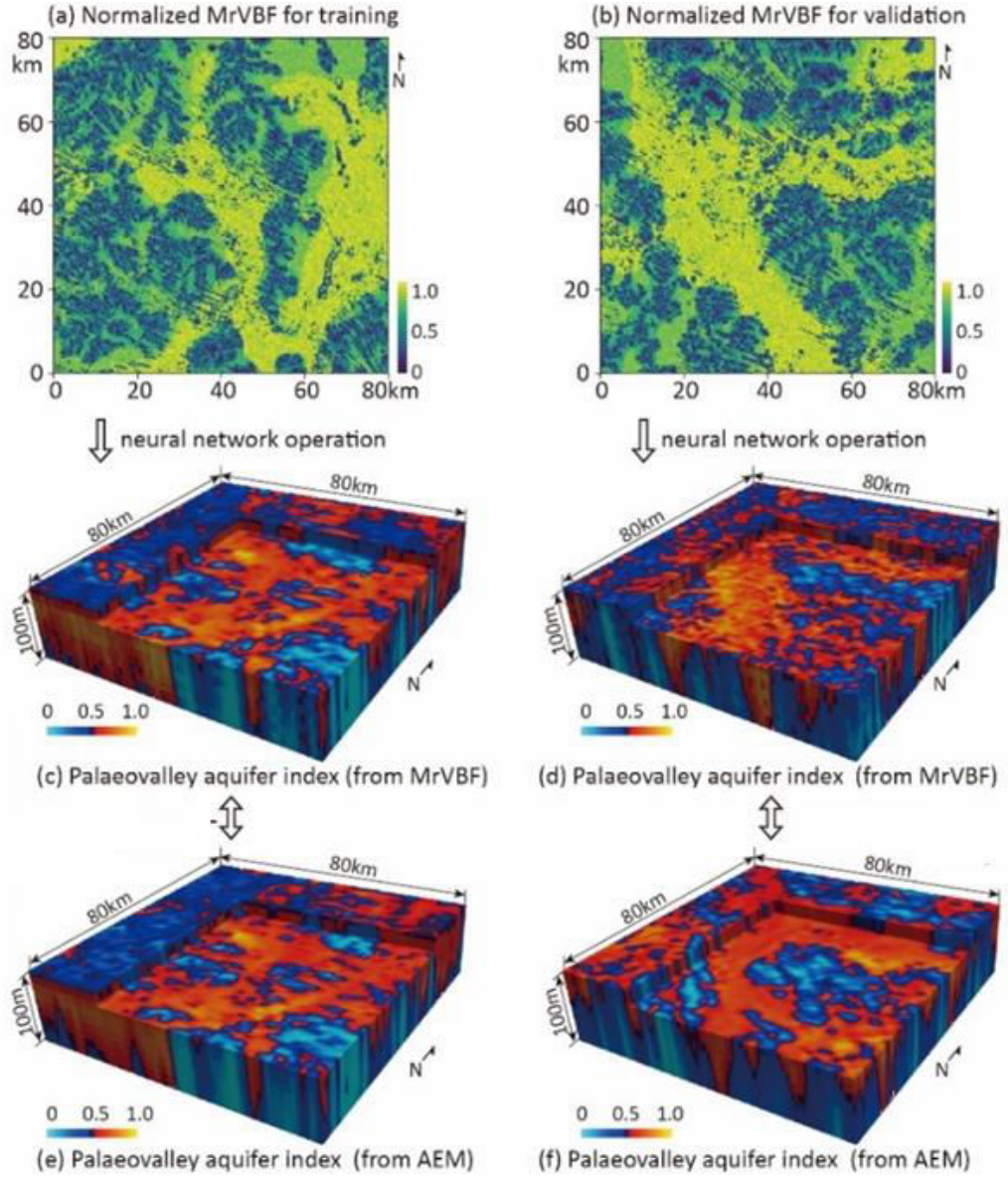
- DEM everywhere
- AEM-paleovalley somewhere

- Sub3DNet: DEM to 3D Paleovalley
- Prediction of 3D paleovalley by DEM

2. Method & application



- Loss of training: < 0.1
- Loss of validation: < 0.1 at over 90% domain



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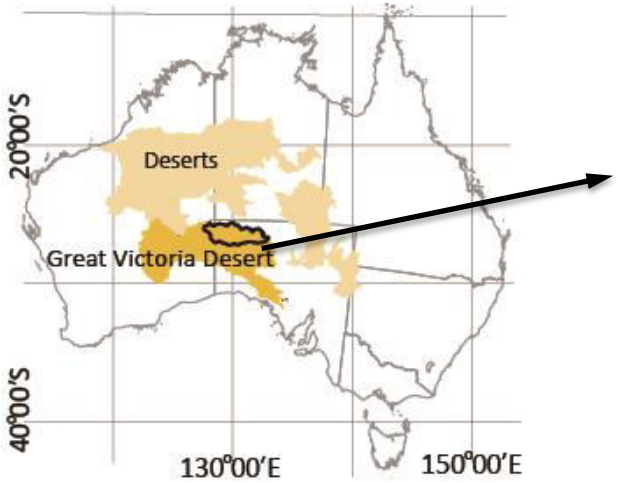
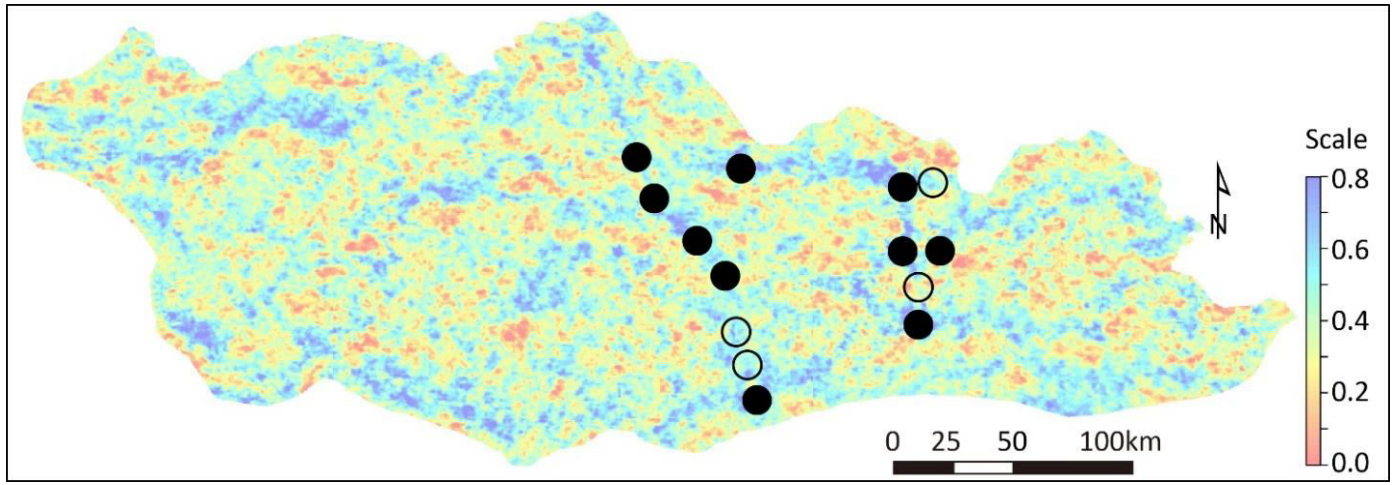




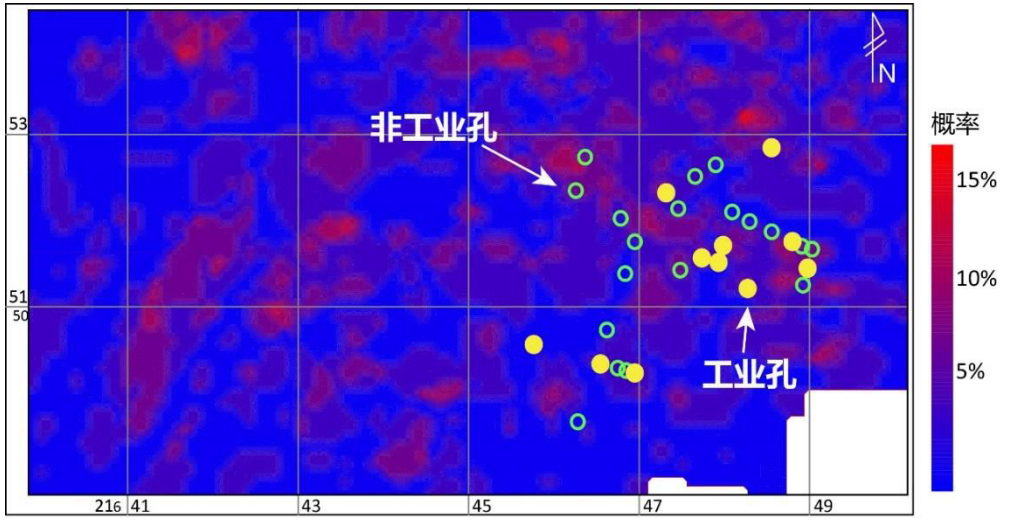
North Victoria desert application and downhole test

Testing with downhole logs, accuracy: 78.5%

2. Method & application

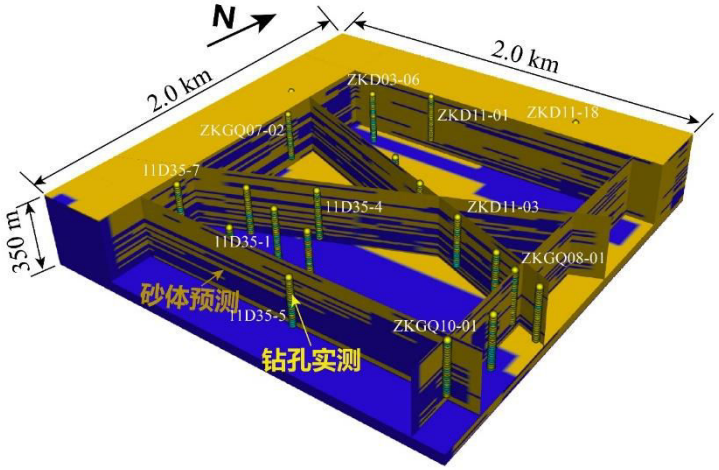
Application to Daqing, China:

- **Input： 3D seismicity amplitude**
- **Output: 3D paleovalley and uranium deposit**
- **Paleovalley accuracy: 83%， uranium accuracy: 78%**
- **Generating a probability map of uranium**

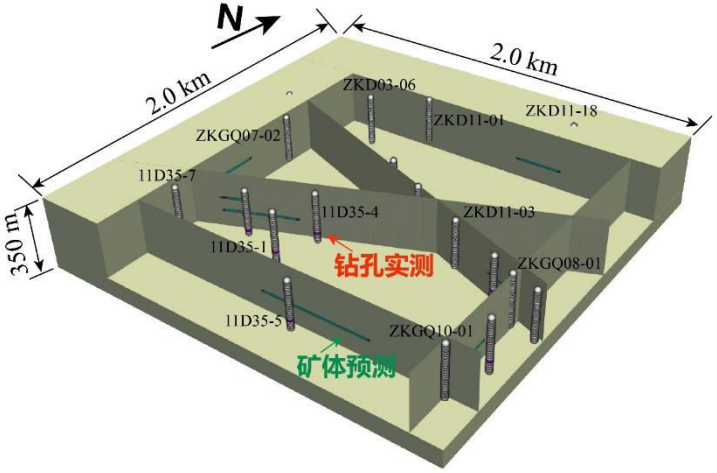


Potential map of uranium

Location of study area



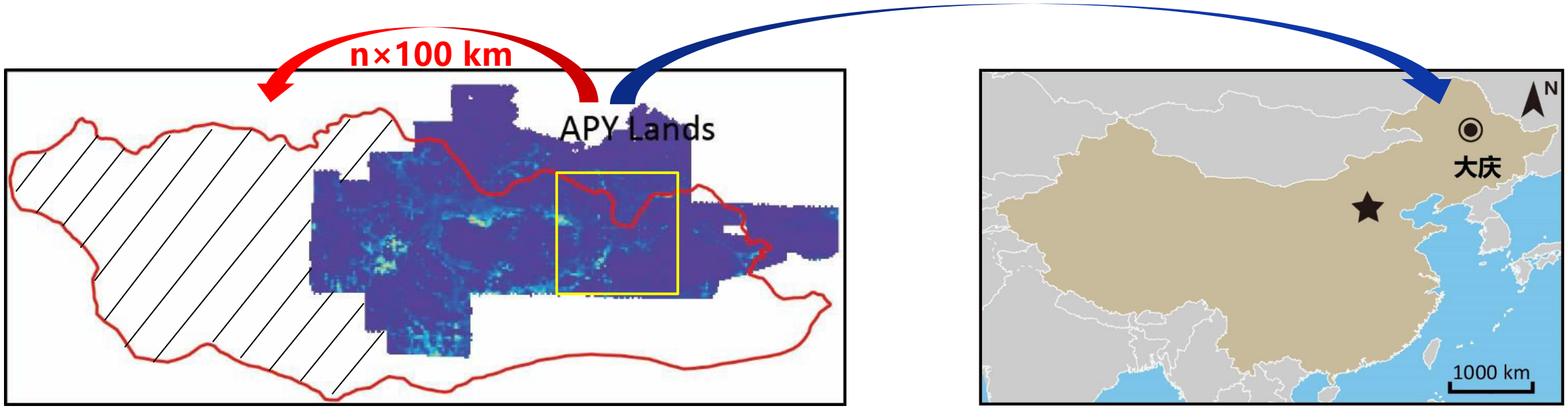
3D paleovalley sediments



3D uranium deposition

3. Conclusion & Outlook

Sub3DNet：subsurface imaging in remote zone featuring limited data, by data mining and information transferring; success in local scale information transferring



Cross-continental transferring, Cross-data-types transferring?

Acknowledgement

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