SA Geology: Laying the groundwork for an integrated approach to geological mapping

SA Discovery Mapping

Jonathan Irvine | 27 November 2025

GEOLOGICAL SURVEY OF South Australia

DISCOVERY DAY

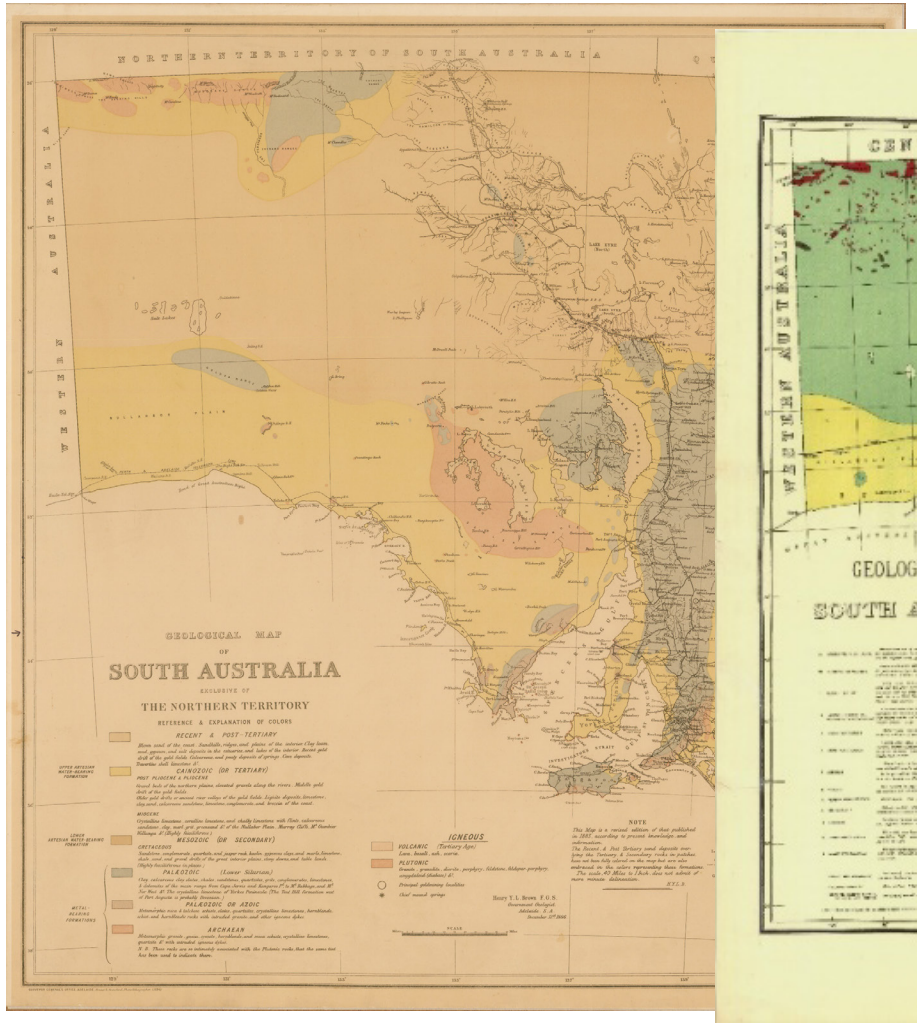
We have always done it this way…

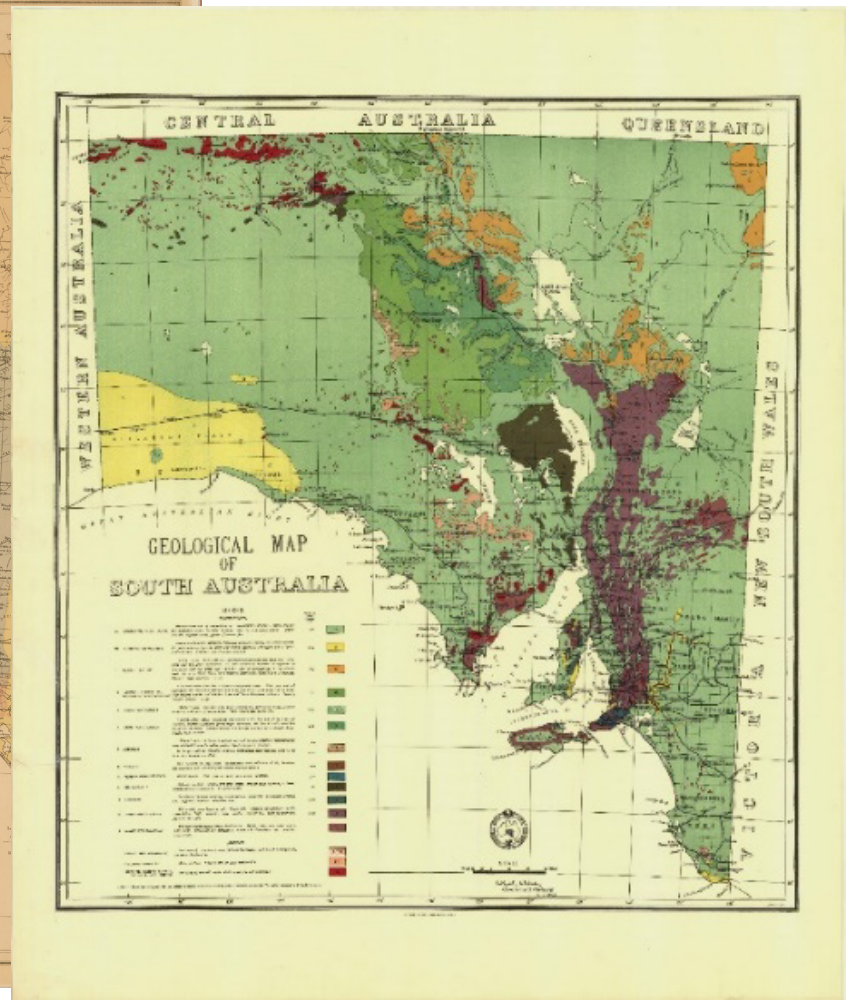
The Geological Survey of South Australia (GSSA) is responsible for the compilation and publication of geological maps for the whole of the State. Products include regional surface geological maps at various scales, solid geology interpretive maps, thematic maps, remote sensed spectral maps and mineral occurrence maps.

1882

1886

1928





GSSA
DISCOVERY DAY

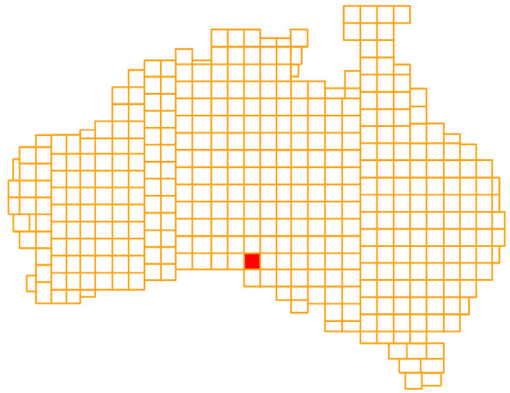
Formalised 250k mapping and a reinvigorated survey

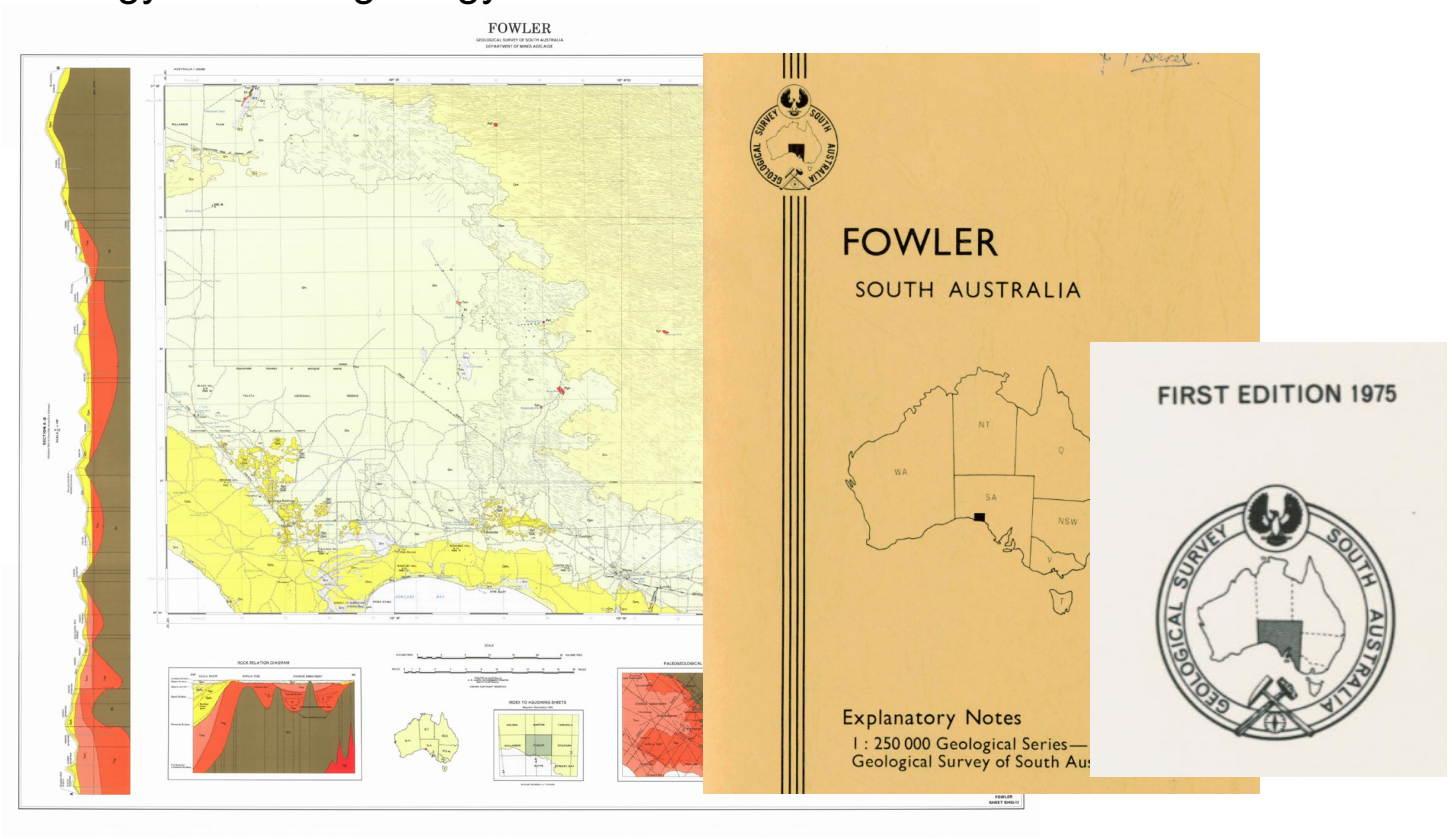
The 1:250 000 geological map series was produced and published by the GSSA between 1954 and 2015.

- These maps were produced in two distinct series, the first using traditional lithographic printing, and the second series using Geographic Information Systems (GIS) techniques.
- ~73 maps were published in this series and some have two editions.
- Released as the “Seamless” 100k Geology - surface geology.

1943

1975





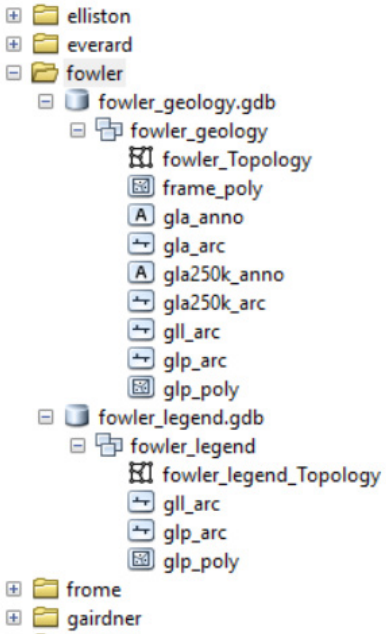
GSSA
DISCOVERY DAY

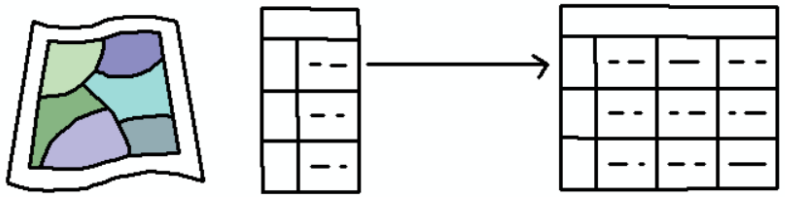
Didn’t we already modernise back in the 80’s?

1989

In 1989, SA GEOLOGY was to become a computerised geological map database system for the capture, storage, manipulation, viewing and plotting of statewide geological map data.

- Developed by the then Regional Geology and Drafting Branches.
- Basis for geological map production into the 21st Century.
- Developed and maintained on Esri software.
- Map data layers suitable for several display scales.
- Flexible output options and facilitates publication.
- Geological map requirements 1990 – 2010.





Geological linework & attribute table

Geology Lookup table

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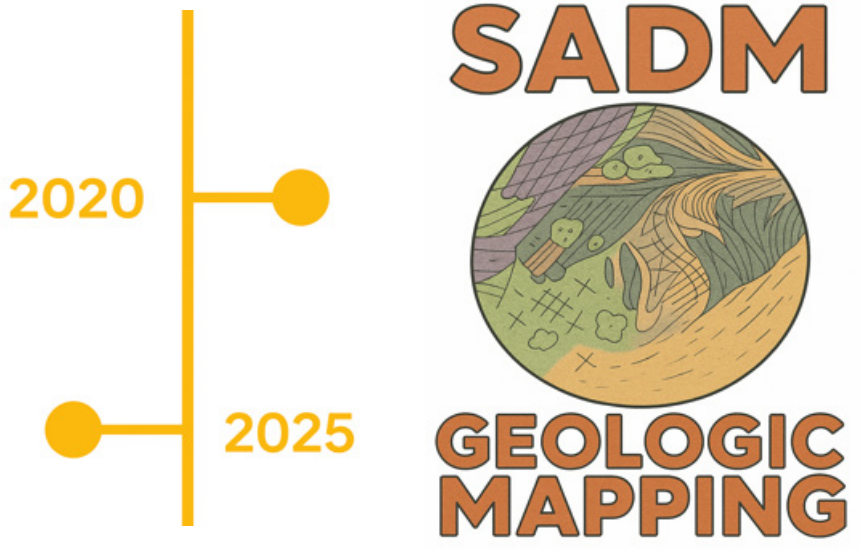
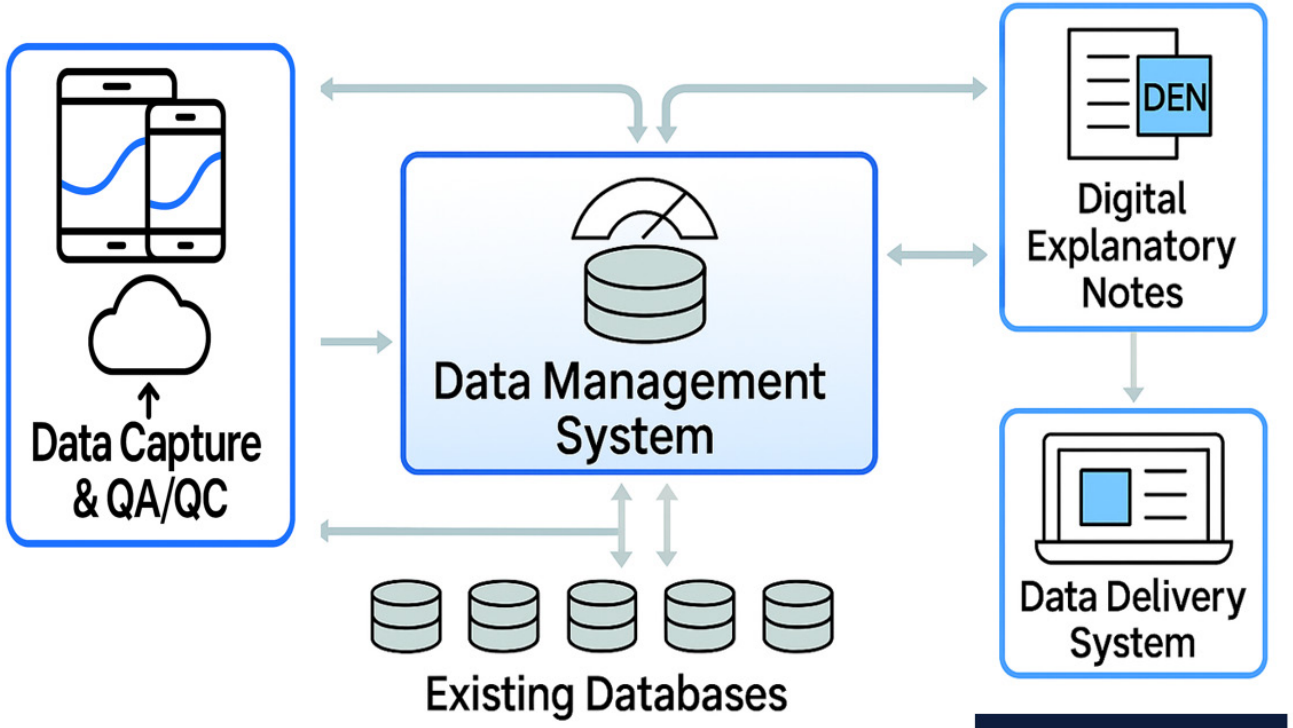
The opportunity: South Australian Discovery Mapping project

The South Australian Discovery Mapping (SADM) project aimed to modernise the capture, management, delivery and scope of the state's precompetitive geological map datasets, creating a modern, world-class geoscience data asset and platform.





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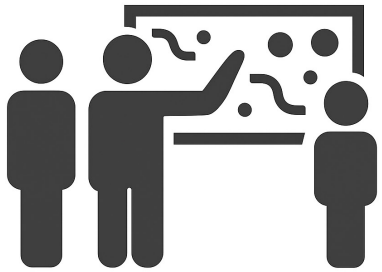
SARIG
South Australian Resources Information Gateway

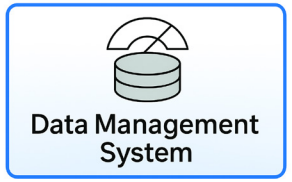
Modern data management system solution

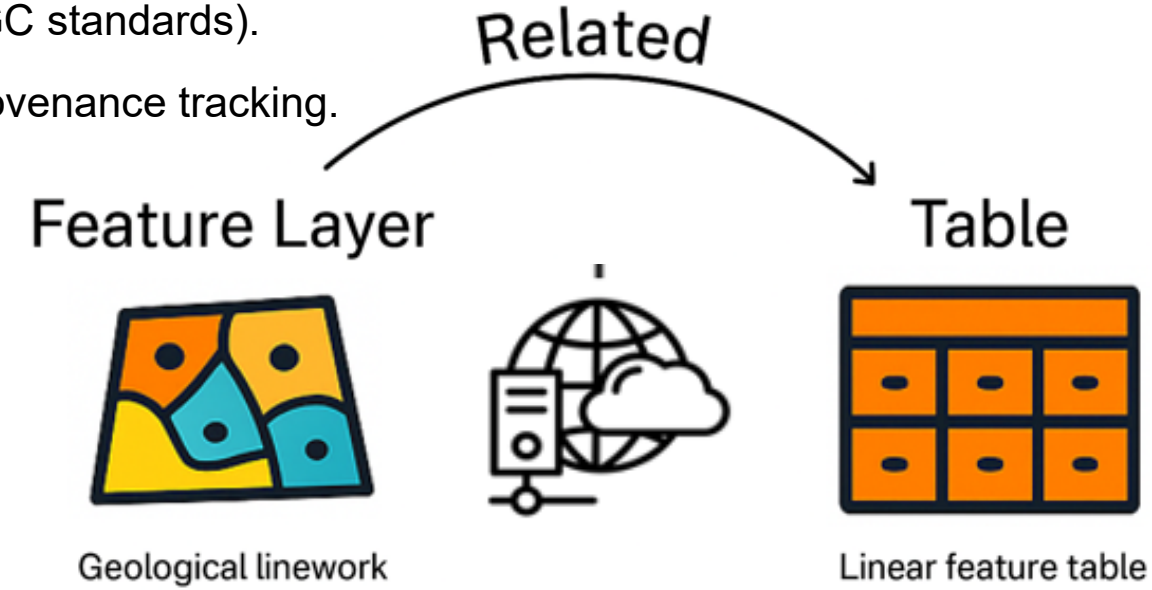
Goal: Create a scalable, interoperable architecture that supports current and future data needs.

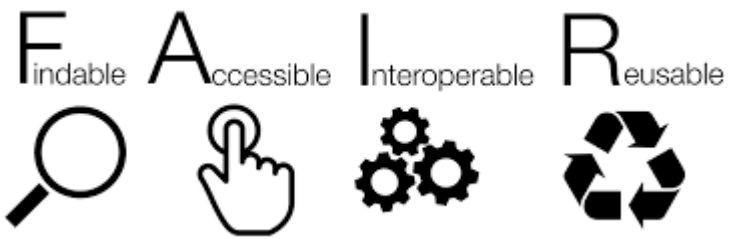
- Use a **modular architecture** with APIs for integration.
- Implement **cloud-based storage** with hybrid options for legacy systems.
- Ensure **data standards compliance** (e.g., GeoSciML, OGC standards).
- Include **metadata management** for discoverability and provenance tracking.



Consultation Report



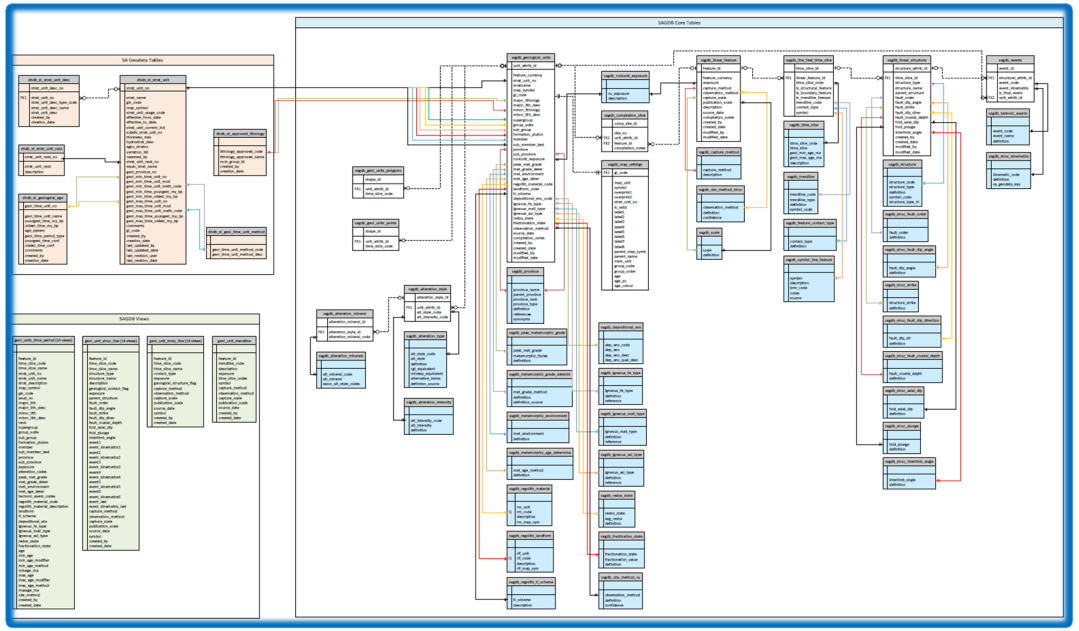




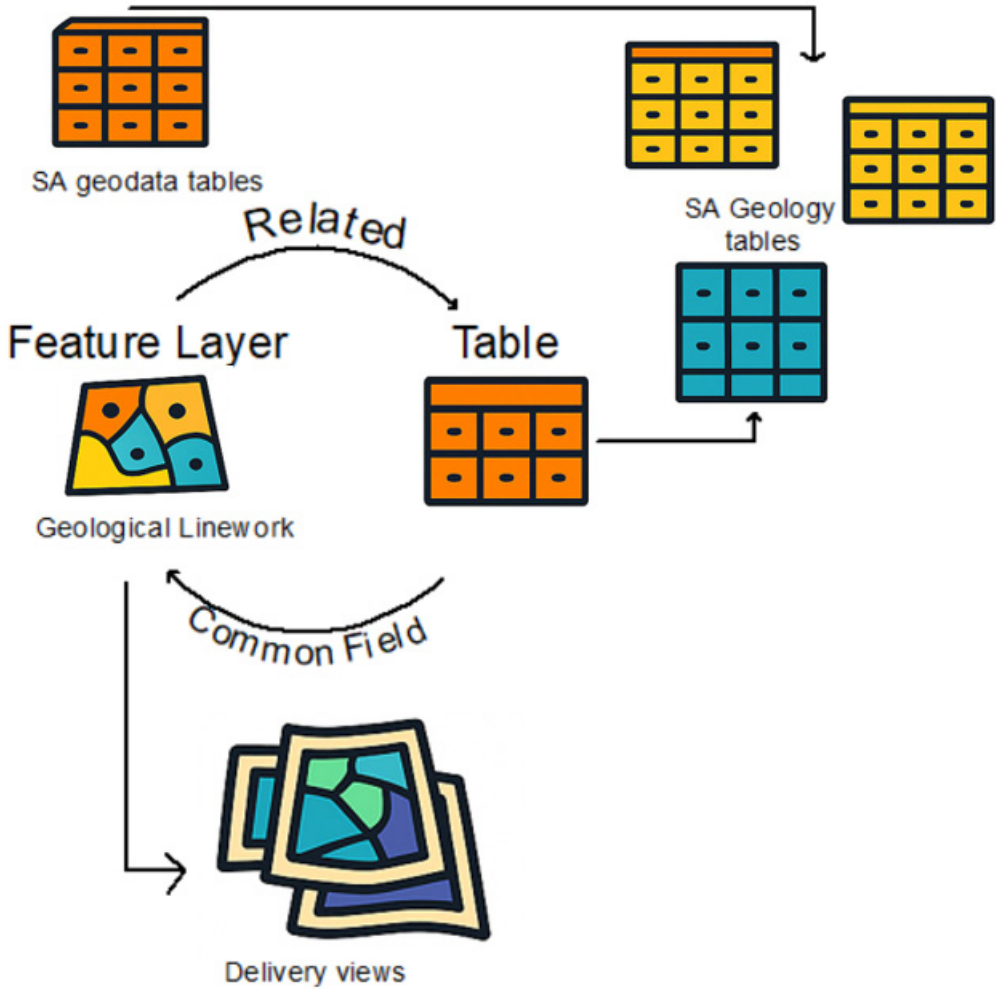
Modern data management system solution

The key system and capability elements and design required to underpin the SADM infrastructure.

- Created a **database schema for geoscience data**, designed for normalised storage of geological observations, structural attributes, and mapping metadata.
- SADM environment to allow **compilers** access from anywhere.
- Seamless integration with **SA Geodata** tabular and spatial datasets.
- Allow simultaneous **multiuser editing** and historical archiving.
- Shared layers as **map services** with feature access capabilities.



Data Management System

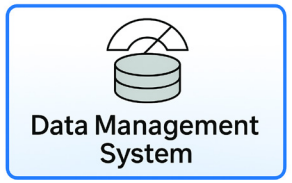


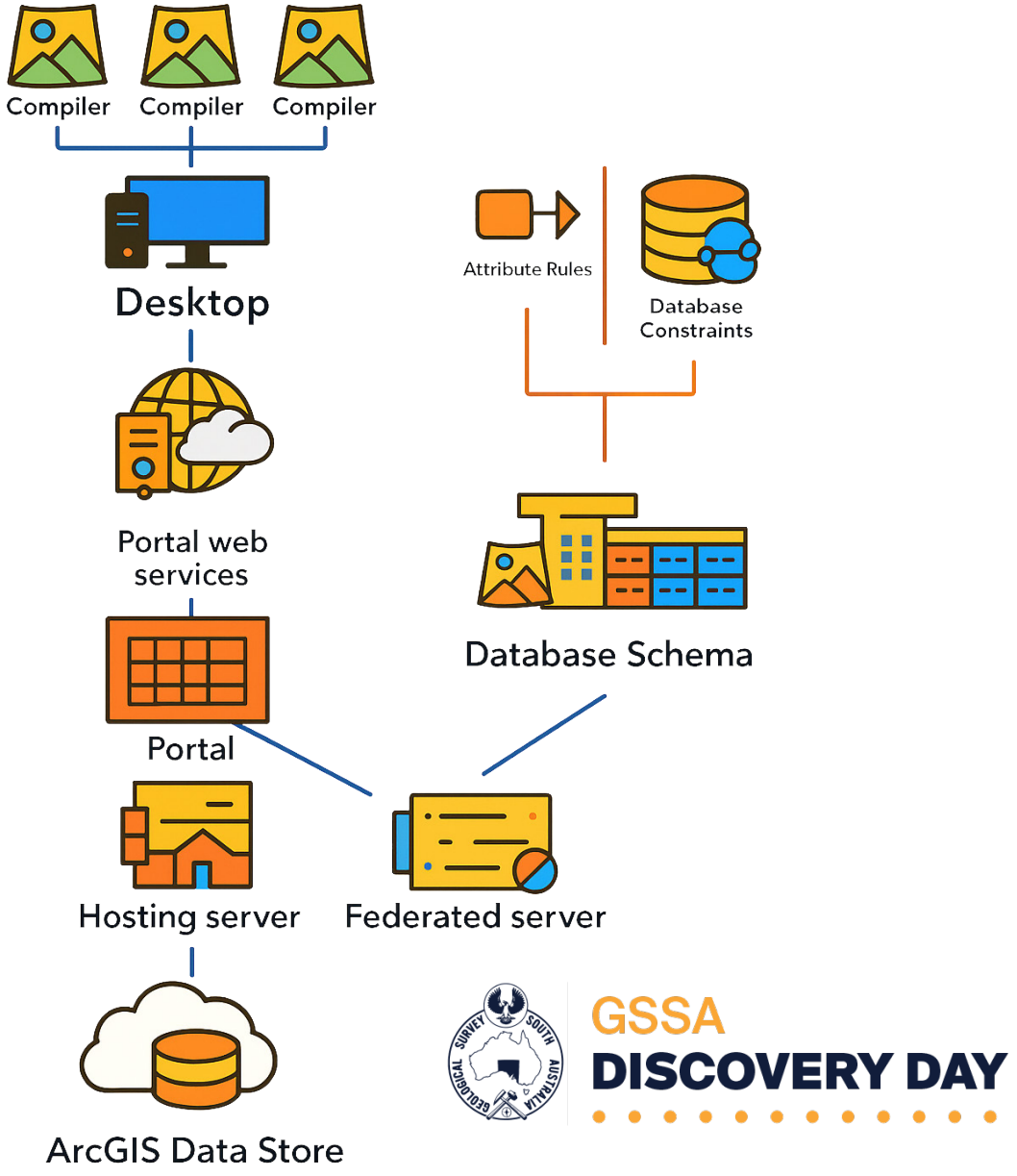
Modern data management system solution

Built on Esri ArcGIS Enterprise, SA Geology 1st edition is a cloud-deployed, relational database system delivering modern spatial and textual geological data.

- Must be able to leverage existing **Enterprise Agreement** licensing.
- The SADM project will assist in increasing the effective adoption of **modern** geospatial technology.

GSSA to have the full capacity of controlling SADM GIS infrastructure and managing dataset editing and publishing workflows.



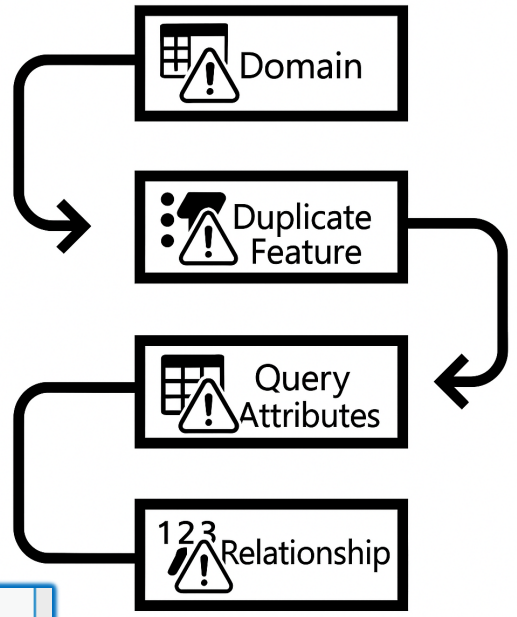


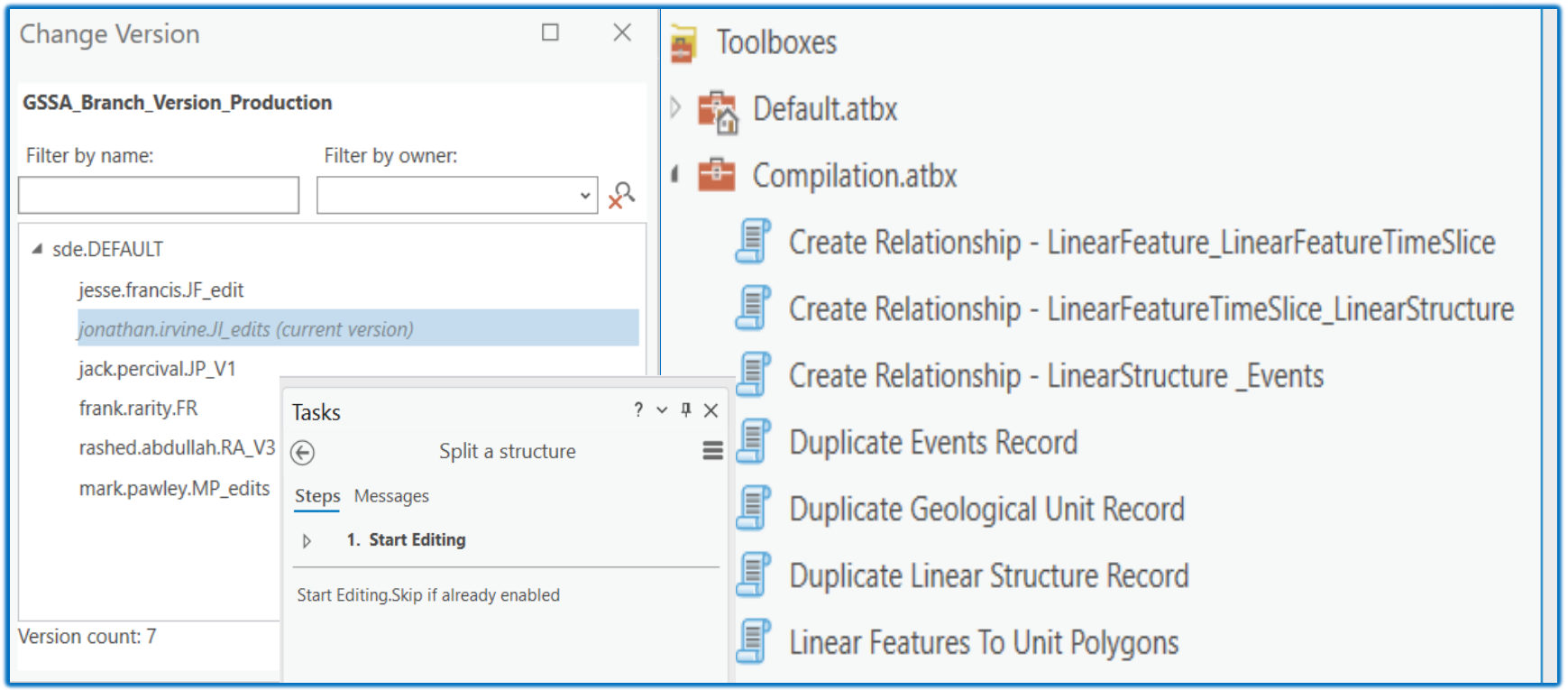
GSSA DISCOVERY DAY

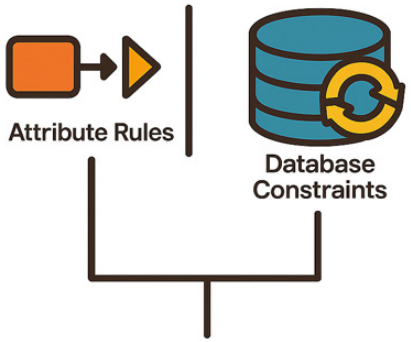
Modern quality control

Goal: Efficiently capture and validate geological mapping data.

- Develop a **Services API** for mapping geologists.
- Integrate **GIS tools** for spatial data input.
- Implement **automated QC checks** (coordinate validation, attribute completeness).
- Support **multiuser data capture** with sync capabilities.







Database Schema

Modern quality control: validation

This focuses on the requirements to develop and maintain a comprehensive auditing and control system to ensure data quality, reliability and consistency.

- Design QA plans to govern data editing workflows.
- Leverage collaboration tools to facilitate registering and tracking data compilation tasks.
- Be able to record **data compilation** notes, tagged against features.
- Adopt a validation process that covers **attributes & geometry** values.
- **Validation checks** to ensure mandatory fields are not empty.

Attribute Rules/Checks

sagdb_linear_feature table (constraint rule)

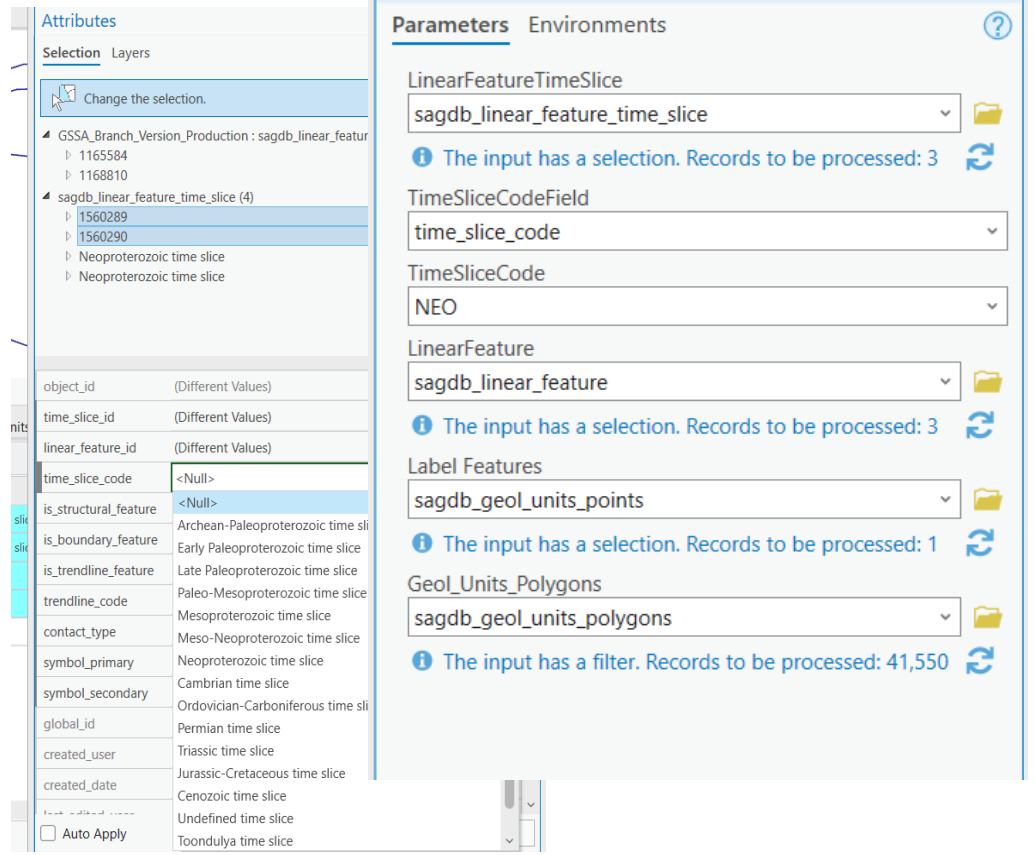
1. Prevent nulling of linear_feature id i.e., PK1 "linear_feature_id ≠ <NULL>"

sagdb_geol_unit_points (validation rule)

1. **Flag a validation error if** " time_slice_code= <NULL>"
   - **Error Message:** *All geological unit's points must have a time slice code.*

sagdb_geol_unit_polygon (validation rule)

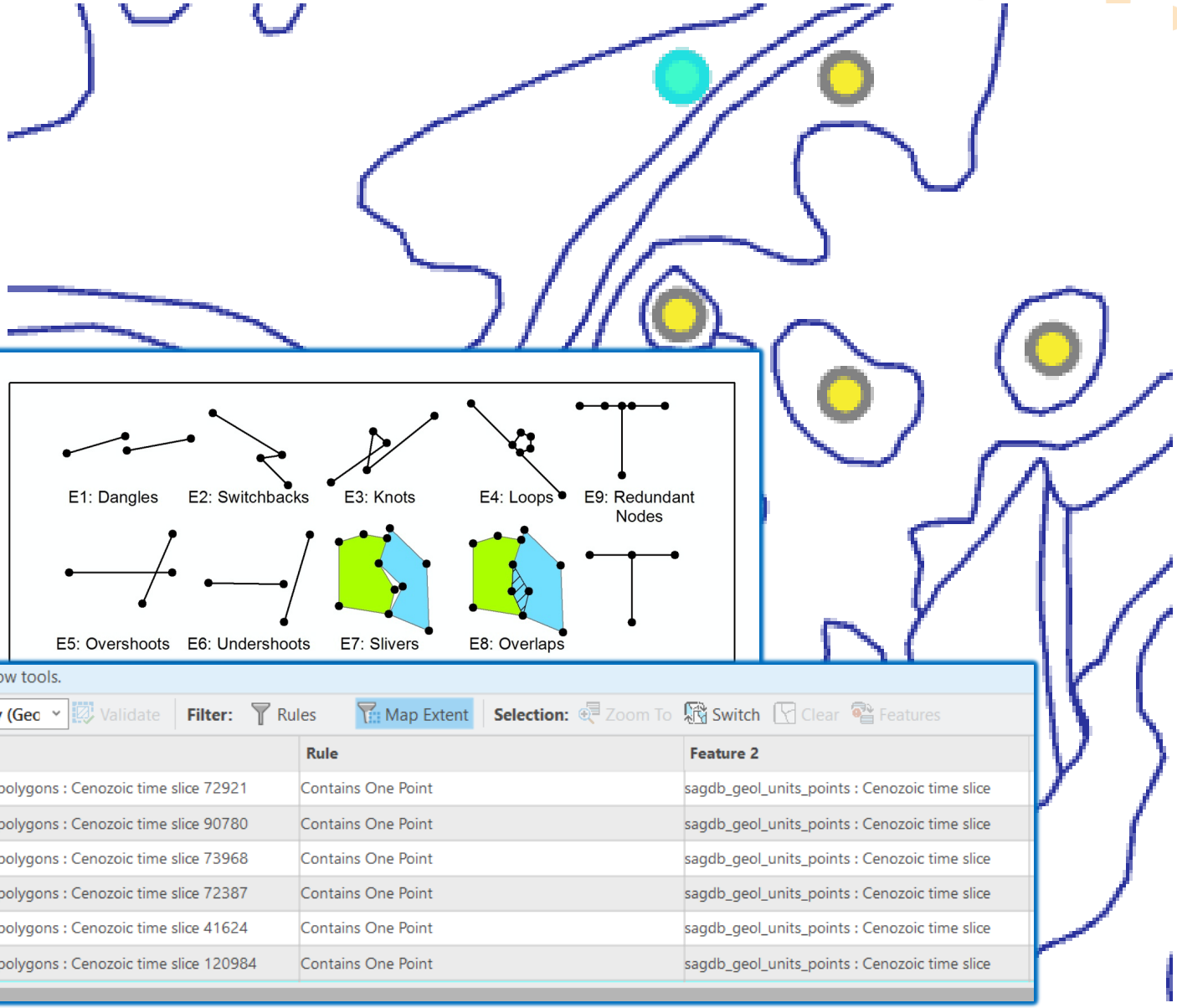
1. **Flag a validation error if** " time_slice_code= <NULL>"
   - **Error Message:** *All geological unit's polygons must have a time slice code.*

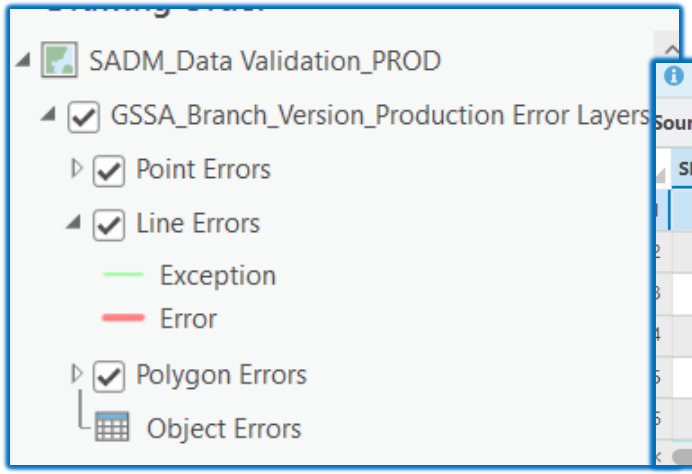


Modern quality control: validation

Esri ArcGIS Enterprise gives us a modern, interactive Quality Assurance (QA) and editing workflows can streamline data integration, reduce manual effort, and improve confidence in spatial outputs.

- Implement **topology rules** that align with the existing SA Geology.
- Implement **attribute rules** to add logic directly to our Enterprise Geodatabase workflows.
- The number of attribute fields required to be populated during the data editing process should be kept to a minimum to reduce editing time.





Modern quality control: Clean data is not optional!

Reliable, validated data is the foundation of a trustworthy database.

- **Constraint Rules** prevent invalid edits at the time of entry.
- **Calculation Rules** automatically compute or update attribute values during editing. This reduces manual data entry and enforces consistency.
- **Validation Rules flag** features as valid or invalid during quality control checks, allowing for later review instead of blocking edits immediately.

time_slice_code	is_structural_feature	is_boundary_feature	is_trendline_feature
Neoproterozoic time slice	No	Yes	No
Neoproterozoic time slice	No	Yes	No
Undefined time slice	No	Yes	No
Undefined time slice	No		
<Null>	<Null>		
<Null>	<Null>		

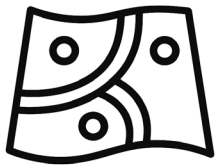
Error Message:
All geological lines must have a time slice code

Flag a validation error

symbol	time_slice
28	NULL

sagdb_line_feat_time_slice

Compiler



Geological Line Work

Validation Rule

Rule Name	Description
LinearFeatureId_IsNull	Record should contain linear_feature_id
LinearFeatureId_IsNull	Record should contain linear_feature_id
LinearFeatureId_IsNull	Record should contain linear_feature_id
TimeSliceId_IsNull	time_slice_id should not be null
LinearFeatureId_IsNull	Record should contain linear_feature_id

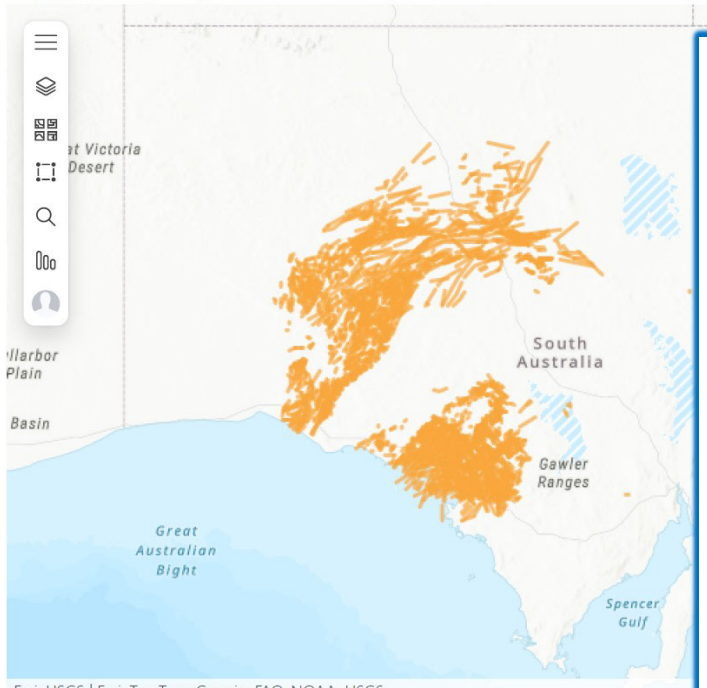
GSSA DISCOVERY DAY

Modern quality control: Dashboards

Facilitating and tracking data compilation tasks and issues = **Dashboards!**

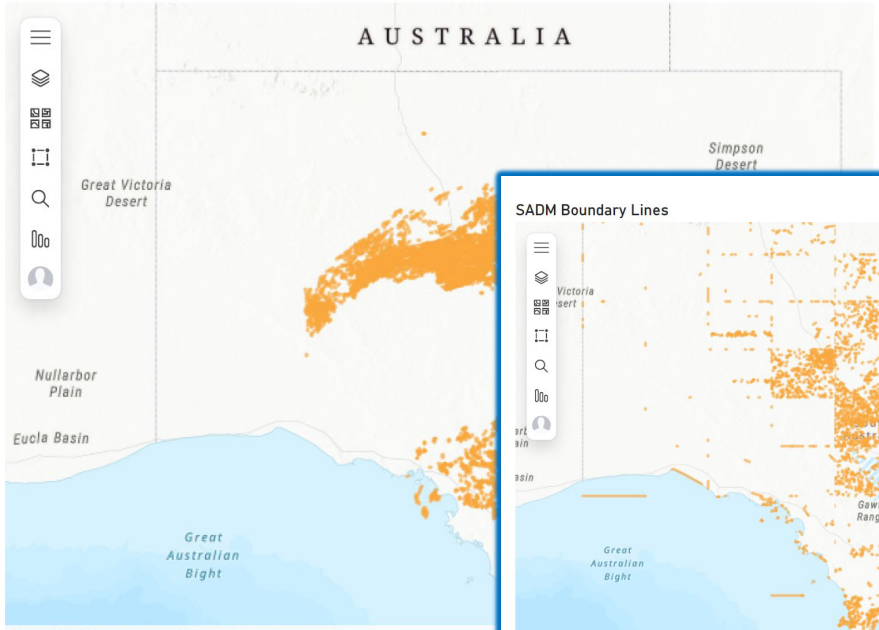
- Minimum attribution goals achieved!

SADM Structure Lines



linear_feature_id	time_slice_code	time_slice
{000673F8-251E-4DFB-B5DC-13F0EF7F9BAE}	LPR	Late Paleoproterc
{000953D6-65DD-4F6B-90BC-AD4B392C98CE}	LPR	Late Paleoproterc
{000E811F-ACB0-460F-B273-FD2996715655}	ARP	Archean-Paleopr
{00175E8E-9987-4043-88EE-11105D36EFF9}	PMP	Paleo-Mesoprote
{001B8B8D-0B75-4A74-9B50-CD43D1BF59A7}	LPR	Late Paleoproterc

SADM Trendlines

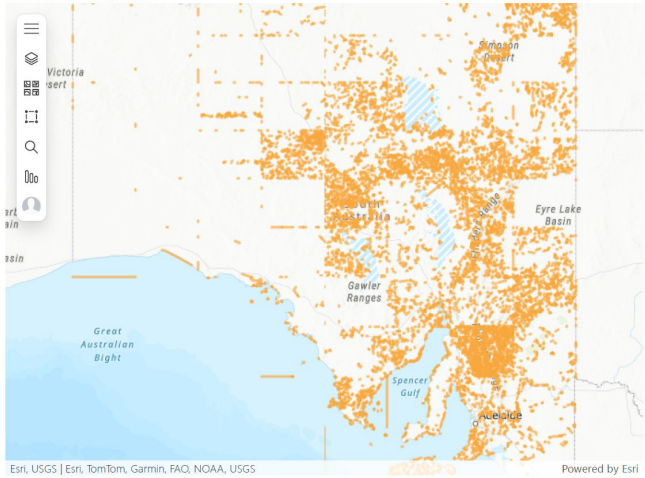


linear_feature_id	time_slice_code
{000E2A15-370D-46BC-896C-1EB60BF2814B}	
{001262F4-33EF-48C0-B5FF-3B9144D89375}	
{001C9B22-803F-4D7A-AF77-4A33CA5790F6}	
{001FE640-BAB1-4033-865F-3401E4F7135A}	
{002003B4-9C02-40B4-84E4-8AA684BE56AD}	

9498

Linear Features with Missing Trendline Type or Time Slice Code

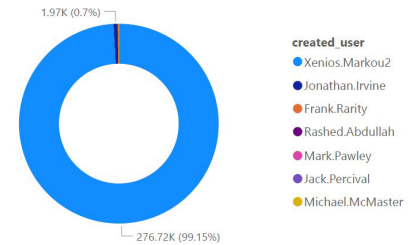
SADM Boundary Lines



279.10K

Linear Features with Missing Contact Type or Time Slice Code

Features by Created User



linear_feature_id	time_slice_code	time_slice	contact_type	description	created_user
{00003BE9-45CA-4E68-B0A4-4099013D0280}	CEN	Cenozoic time slice	N/A	Geological boundary position accurate	Xenios.Markou2
{0000D08A-4491-47D5-9819-B7A4AE40B95A}	CEN	Cenozoic time slice	N/A	Geological boundary position accurate	Xenios.Markou2
{000127D6-4723-42C0-A484-1EBFB8B2D804}	CEN	Cenozoic time slice	N/A	Geological boundary position accurate	Xenios.Markou2
{00012D91-BB2F-42A3-B9EE-4EEEFA396B7E}	CEN	Cenozoic time slice	N/A	Geological boundary position accurate	Xenios.Markou2
{0001A687-E1D3-4C0E-95D9-EF65E842595D}	CEN	Cenozoic time slice	N/A	Geological boundary position accurate	Xenios.Markou2

SA Geology delivery

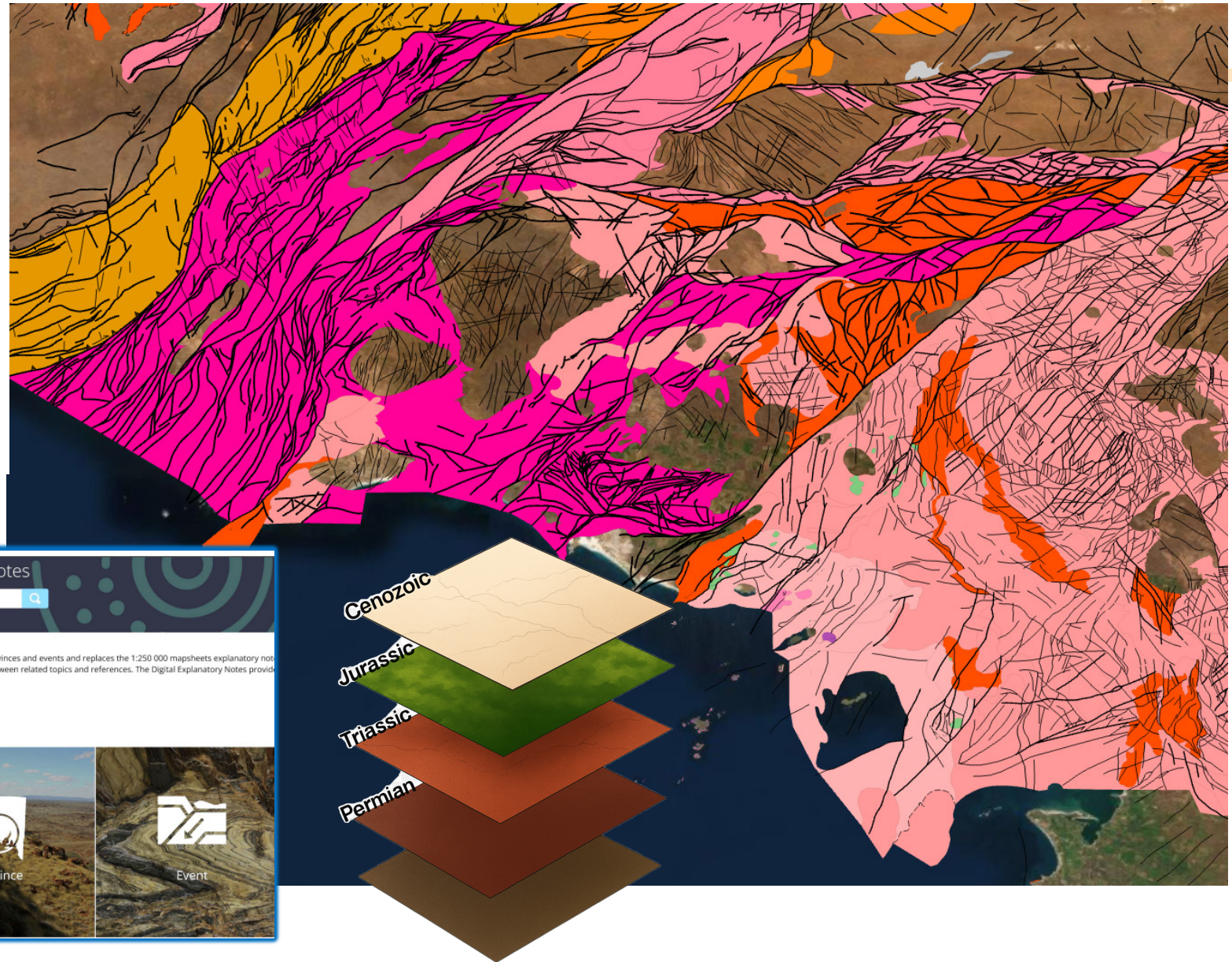
Goal: Deliver data through SARIG and modern web services.

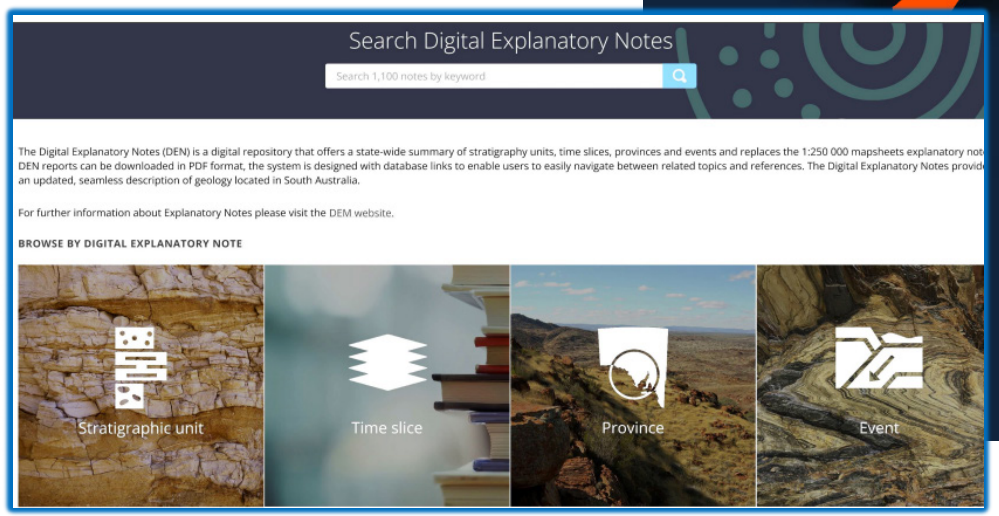
- Implement **Modern API and OGC-compliant services** (WMS, WFS).
- Provide **downloadable datasets** in standard formats.
- Integrate with **SARIG** for visualisation and query.
- Modern **machine-ready** geoscience.

Data Delivery System

SA Geology delivery: What it looks like

- Delivered a new digital explanatory notes system, providing the best available stratigraphic information and replacing individual map sheet notes
- Statewide, seamless Integrated interpreted and exposed geological map layers.
- Time constrained layer set.
- Highest available resolution data.

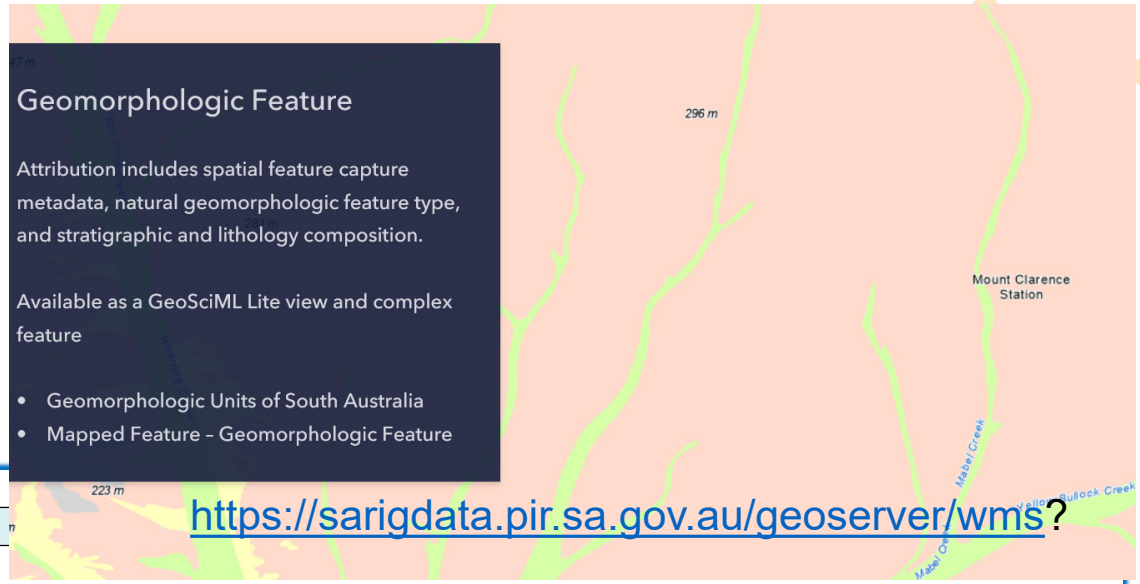




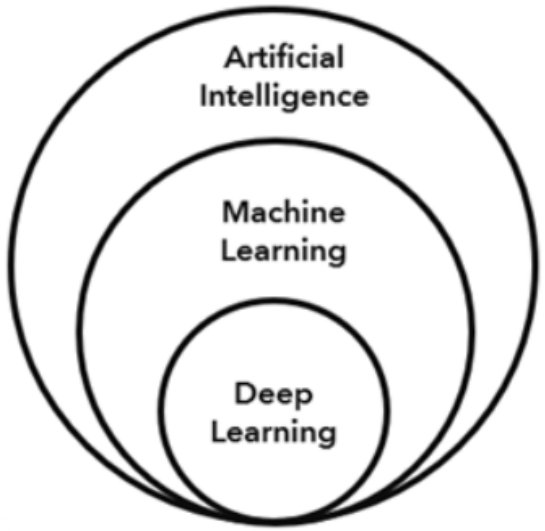
Data Delivery System

SA Geology delivery: What it looks like

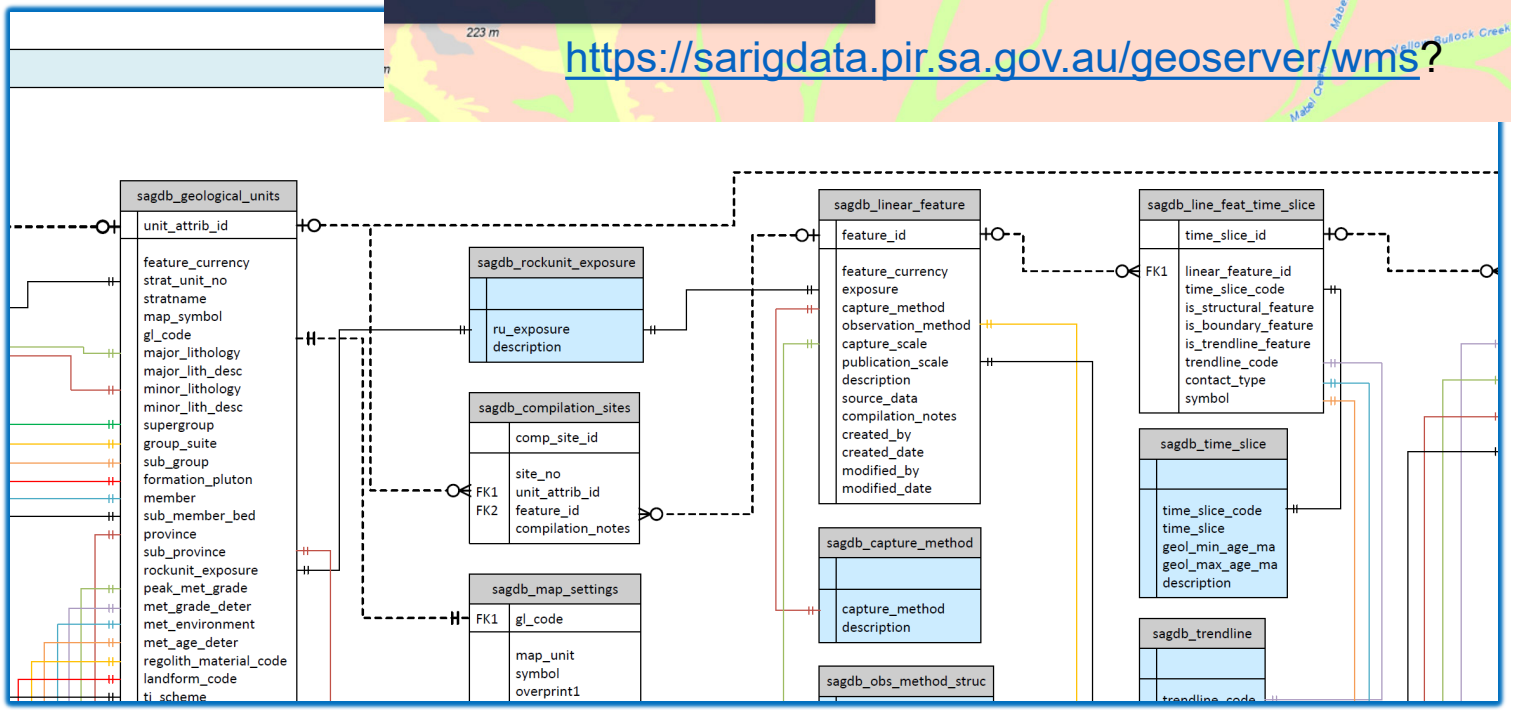
- More robust data and metadata (quality/consistency/quantity).
- More attributes and internally consistent datasets.
- Readily updateable and flexible.
- Consistent stratigraphy across regions.
- Update and fully attribute/define stratigraphic units.
- Data formatted/international standards and machine readable.



https://sarigdata.pir.sa.gov.au/geoserver/wms?

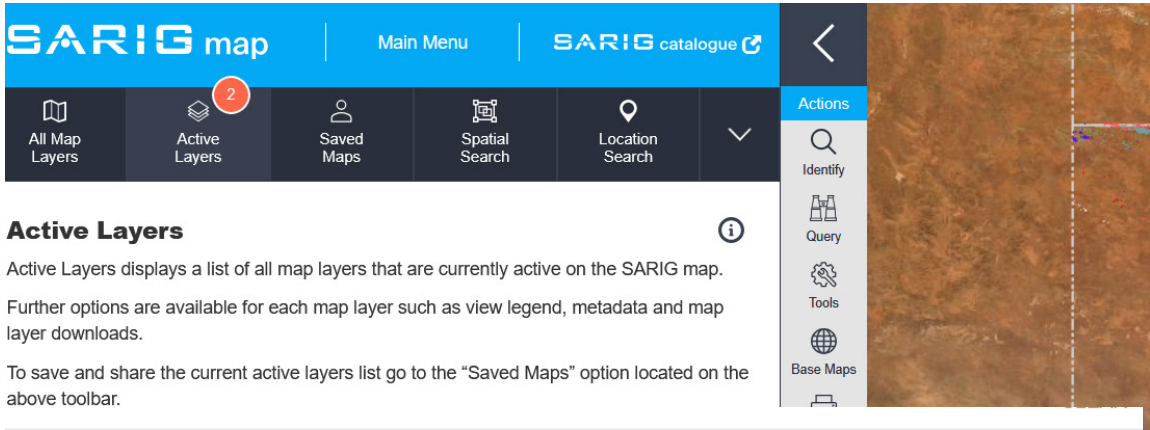


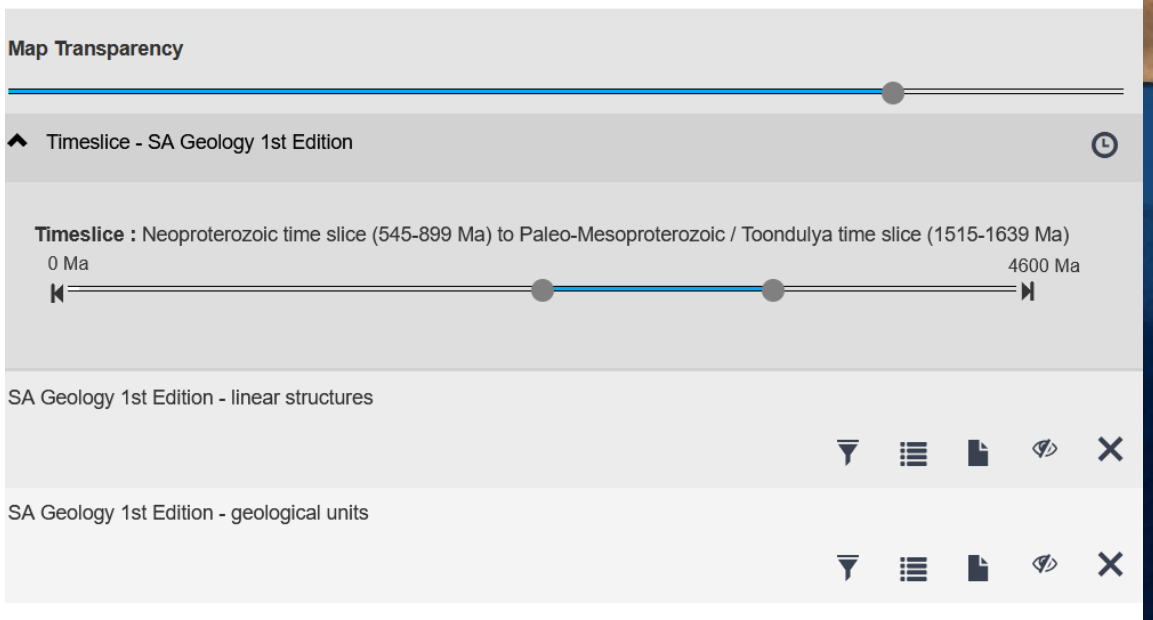
Data Delivery System

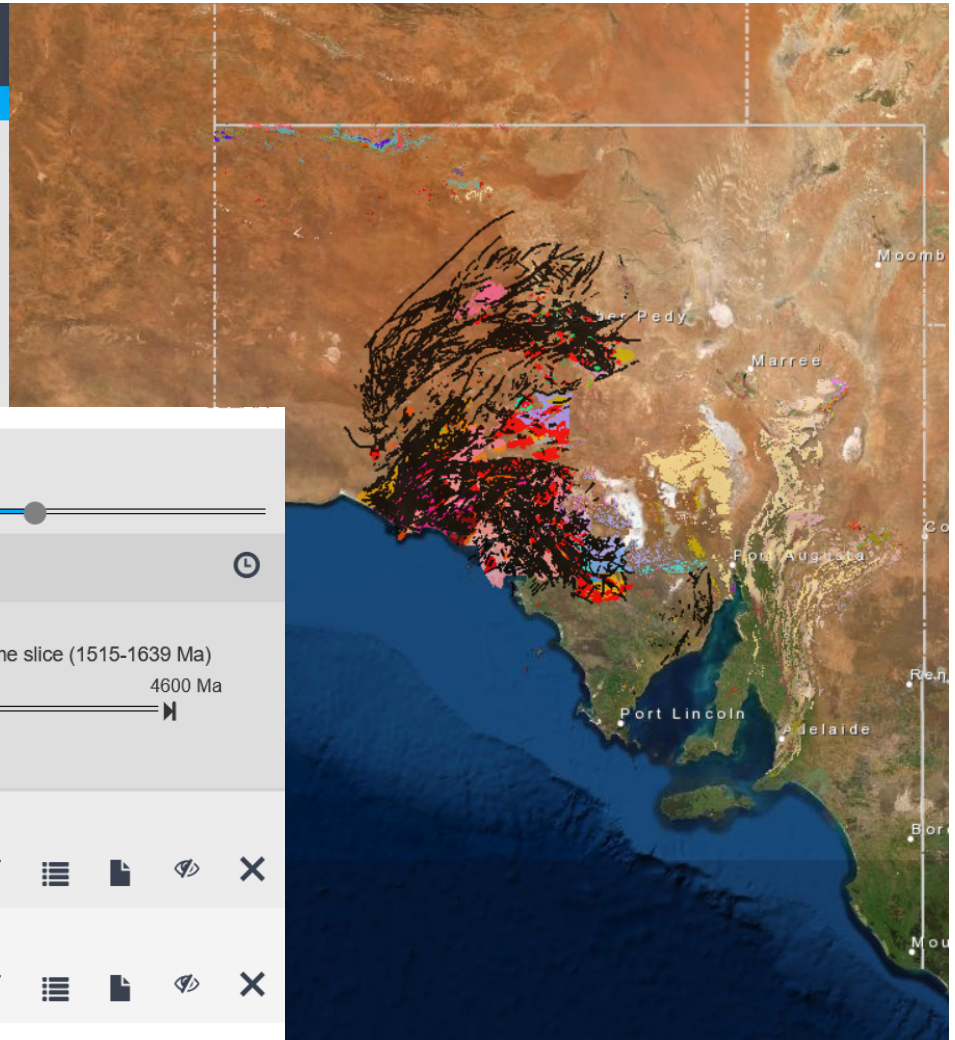


SA Geology delivery: SARIG

- Generating new detailed outcrop and interpreted geological map layers for delivery via SARIG and web services.
- Deliver a digital explanatory notes system, providing the best available stratigraphic information and replacing individual map sheet notes.



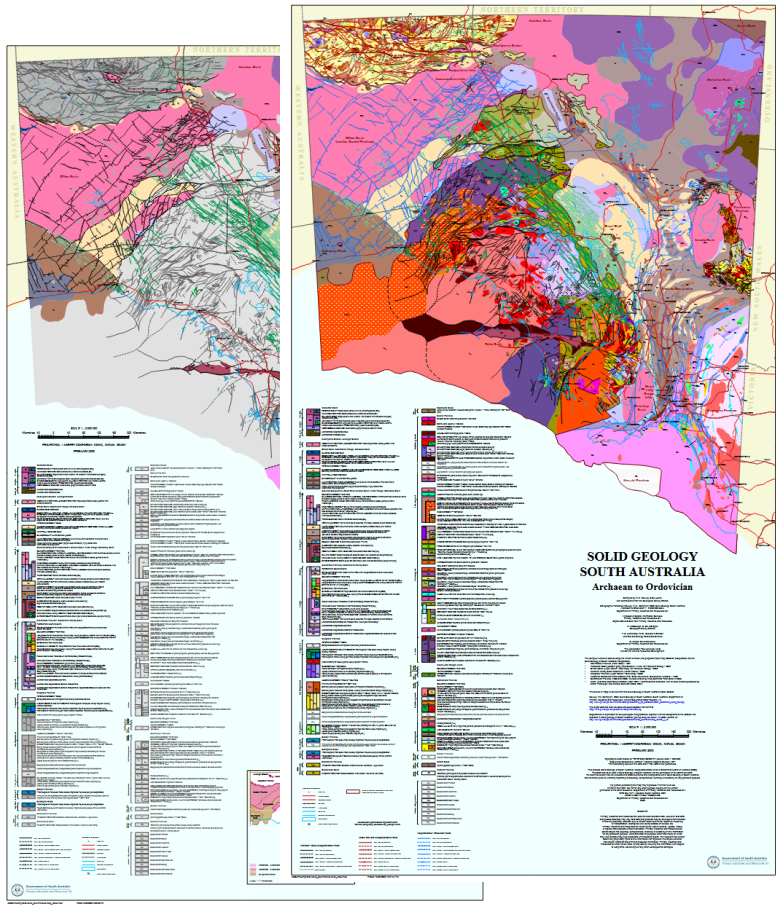


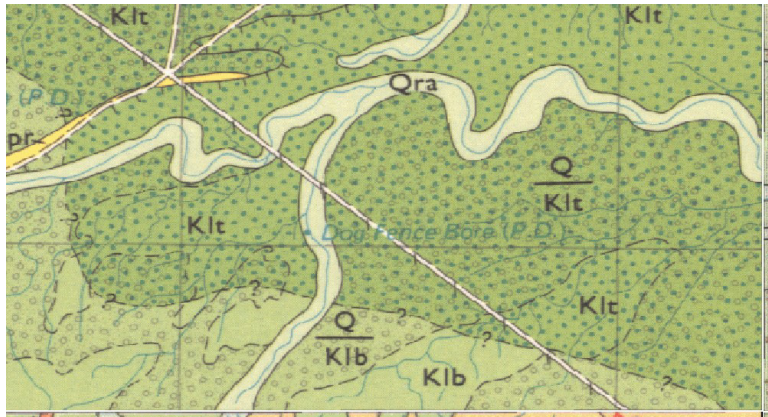


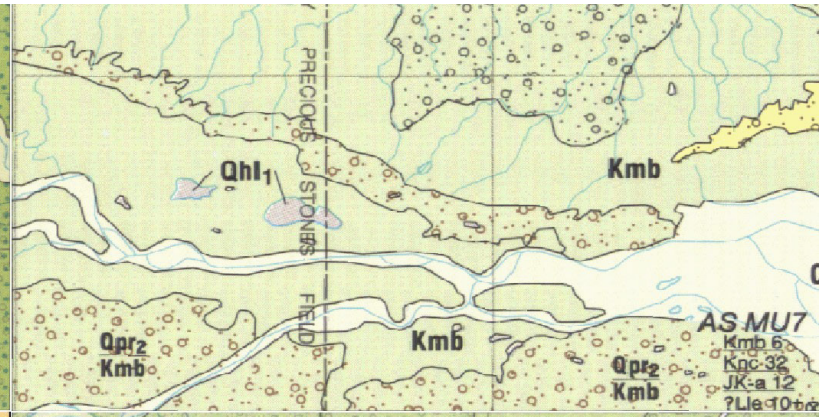
Data Delivery System

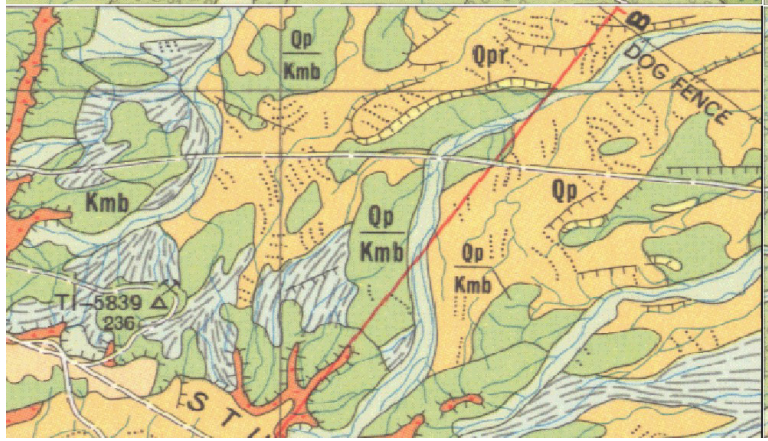
SA Geology: future improvements to seamless data

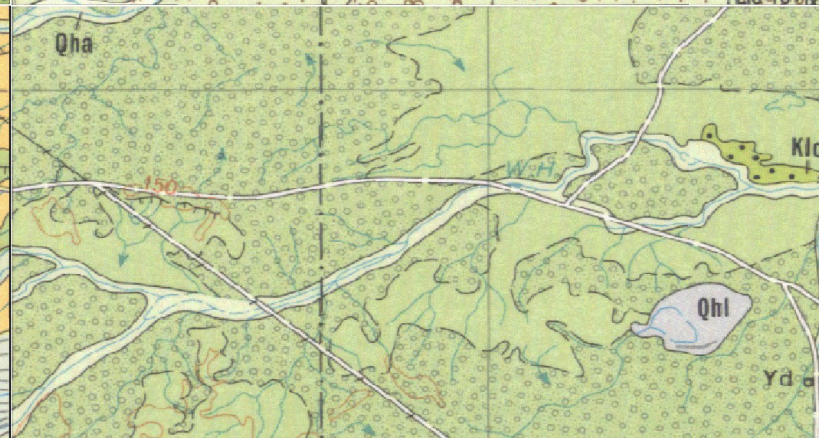
- We need to deal with **adjoining geological interpretations** of map sheets that may be 40+ years apart.
- Integration of the existing **solid geology** layers be incorporated into the rock unit feature classes within the time constrained layers.
- Stay tuned for the **Eastern GCAS** integration next year.











SA Geology: future improvements to seamless data

- Eliminated and reduced the number of “**piggyback**” units within the spatial data.
- Underlying older rock units need to be extended out under younger units within time layers to eliminate the existing 100k geology **cookie-cut data**.
- Some units still occur for those units that exist within a single the Cenozoic time slice.

SA Geology: future improvements

- Can we extrapolate an extent for **unmapped units**?
- Still work to be done on removing **inconsistent stratigraphy**.
- Still considering how to display the varying geological themes.

Strat Name	STRATNO	SADM Status	Timeslice
Aristarchus Metaperidotite	6985	No Mapped Units	ARP
Devils Playground Volcanics	6656	No Mapped Units	ARP
Eba Formation	5443	No Mapped Units	ARP
Mullina Volcanics Member	6392	No Mapped Units	ARP
Apamurra Formation	3250	No Mapped Units	CAM
Cootanoorina Formation	3476	No Mapped Units	CAM
Hawker Group	3634	No Mapped Units	CAM
Hideaway Well Member	3639	No Mapped Units	CAM
Linns Springs Member	3751	No Mapped Units	CAM
Mount Mantell Member	3895	No Mapped Units	CAM
Moyles Chert Marker Bed	3914	No Mapped Units	CAM
Ouldburra Formation	4013	No Mapped Units	CAM
Parakeelya Alkali Member	4028	No Mapped Units	CAM
Second Plain Creek Member	4793	No Mapped Units	CAM
Six Mile Bore Member	4519	No Mapped Units	CAM
Third Plain Creek Member	4204	No Mapped Units	CAM
Wallatinna Member	4262	No Mapped Units	CAM
Winnitinny Creek Member	4541	No Mapped Units	CAM
Mirikata Formation	3827	No Mapped Units	CEN
Loongana Formation	5379	No Mapped Units	JUR
Madura Formation	3767	No Mapped Units	JUR

PLEISTOCENE-HOLOCENE

Qr_1 QUATERNARY REGOLITH/COLLUVIAL UNIT 1: Quaternary gibber-mantled colluvium. Based on Q on MURLOOCOPPIE.

PLEISTOCENE

Qpr_5 PLEISTOCENE REGOLITH/COLLUVIAL UNIT 5: Pleistocene red sand with maghemite gravel veneer, typically mulga-covered.

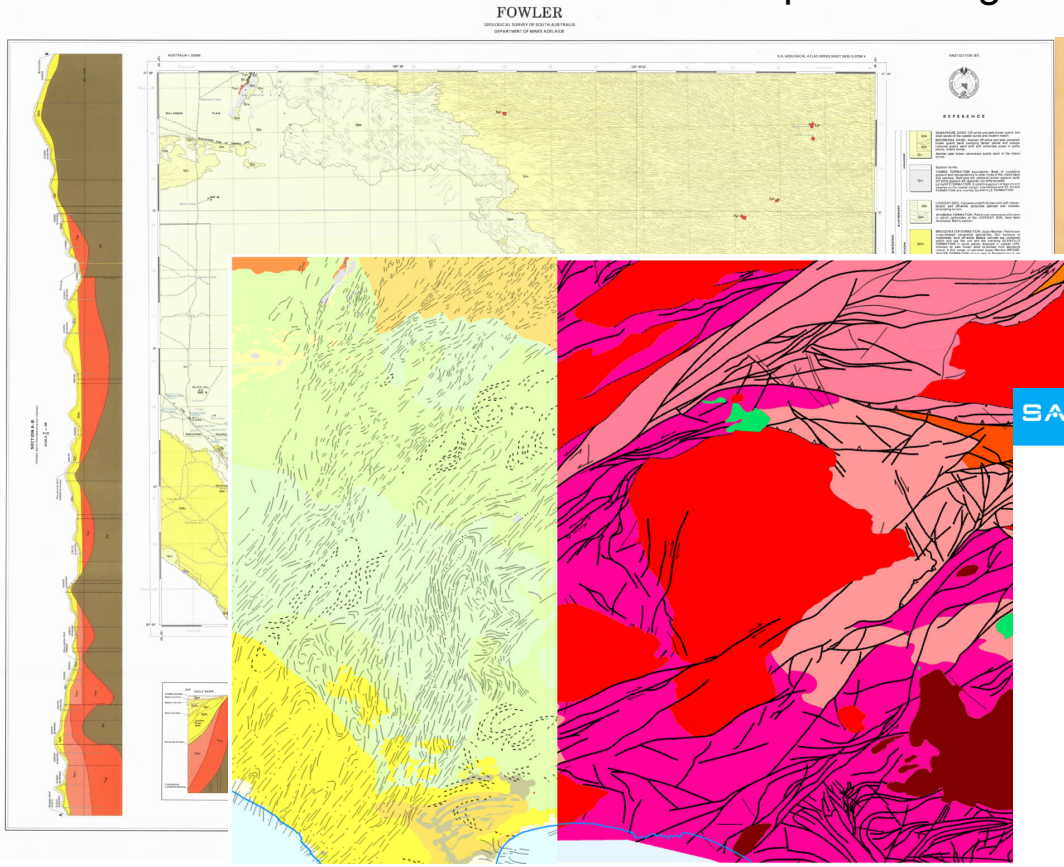
Qpr_6 PLEISTOCENE REGOLITH/COLLUVIAL UNIT 6: Pleistocene ironstone gravel spreads on alluvium and colluvium. Based on blue dot overprint within Qa on CURDIMURKA, Q2 on KINGOONYA.

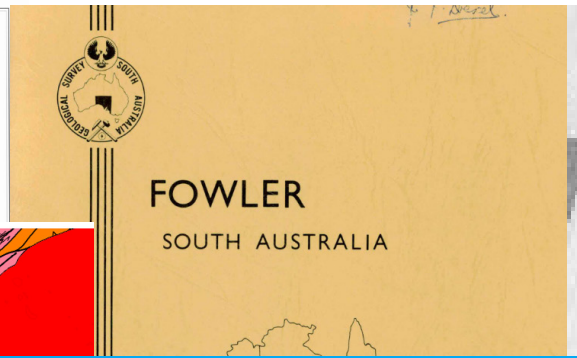
Qp\ca PLEISTOCENE CALCRETE: Undifferentiated Pleistocene calcrete.

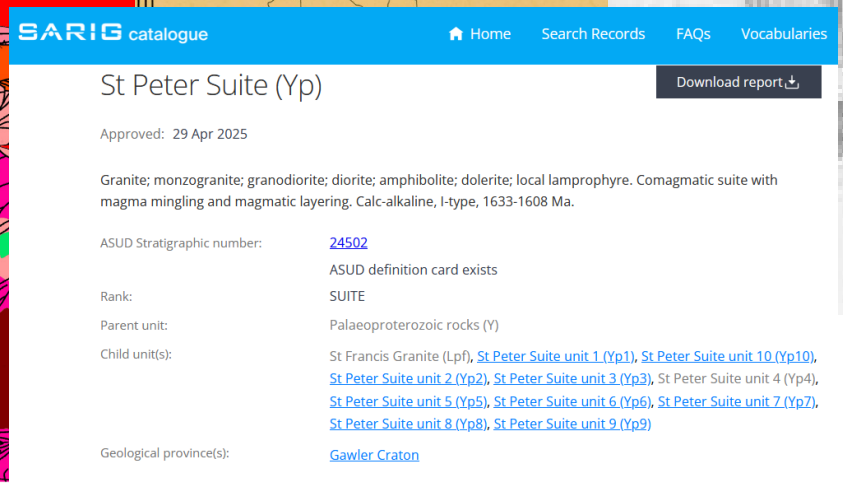
- [x] Mesoproterozoic time slice (1250-1514Ma)
  - [x] Mesoproterozoic time slice (1250-1514 Ma) - linear structures
  - [x] Mesoproterozoic time slice (1250-1514 Ma) - boundaries
  - [x] Mesoproterozoic time slice (1250-1514 Ma) - geological units (Overprint)
  - [ ] Mesoproterozoic time slice (1250-1514 Ma) - geological units (Mapunit)
  - [ ] Mesoproterozoic time slice (1250-1514 Ma) - geological units (Age)

SA Geology summary

- The GSSA has upgraded to a next generation platform for Mapped geology.
- From compilation to release the GSSA is ensuring timely updates and data-rich products.
- The integration of spatial data and geological notes delivers a smarter way to understand our geology.
- South Australia can unlock its competitive edge with machine-ready geoscience.







Disclaimer

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Acknowledgement of Country

As guests here on Kaurna land, the Department for Energy and Mining (DEM) acknowledges everything this department does impacts on Aboriginal country, the sea, the sky, its people, and the spiritual and cultural connections which have existed since the first sunrise. Our responsibility is to share our collective knowledge, recognise a difficult history, respect the relationships made over time, and create a stronger future. We are ready to walk, learn and work together.