Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.38304

A Systematic Approach to Enabling Geochemical Data to meet Open Science Mandates, be FAIR, CARE and TRUST Compliant, as well as AI-ready and Decision-ready.

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Increasingly funders demand researchers meet Open Science Mandates, and that data comply with the FAIR, CARE and TRUST principles. Rapidly evolving Artificial Intelligence (AI) and Machine Learning (ML) systems require geochemical datasets to be AI-Ready, whilst reuse of data in evidence-based policy and resource decisions demands 'Decision-ready' datasets that meet legal requirements for due diligence and chain-of-custody.

'Open Science' is a set of practices that go beyond open data, ensuring the full scientific process is open and accessible to everyone.

The **'FAIR Guiding Principles for scientific data management and stewardship'** focus on enabling machines to find and access datasets, and enhance their reuse and aggregation. FAIR requires rich and compliant (meta)data with agreed-upon community standards for machine-readability.

The '**CARE Principles for Indigenous Data Governance'** are a prerequisite to support Indigenous rights in research data and practices to enable alignment with the UN Declaration on the Rights of Indigenous Peoples. Critical to CARE (Collective Benefit, Authority to Control, Responsibility, and Ethics) for geochemical data is the provenance of samples used in analysis, and evidence of partnerships with Traditional Custodians.

The '**ESIP AI-readiness guidelines'** require even richer metadata around four factors: Quality, Documentation, Access, and Preparation. Specific to geochemical data are machine-actionable documentation of QA/QC procedures applied (Quality), and methods used to generate and analyse data (Preparation).

The '**TRUST Principles for Digital Repositories'** (Transparency, Responsibility, User focus, Sustainability and Technology), as well as repository certification (e.g., CoreTrustSeal), demonstrate repository trustworthiness and ensure data curated by them can be reused with confidence.

'Decision-Ready data' requires the highest level of trust and facilitates use of data in courts of law by providing verifiable documentation of any activity and any actor involved in any transformation.

All these are critically dependent on agreed protocols, best practices and standards. However, many researchers find compliance with these mandates, principles and guidelines overwhelming. OneGeochemistry is a global initiative that brings together major geochemical data providers and researchers to establish global standards and best practices. This paper will present examples of how researchers have been enabled to meet some of these rather complex, overlapping, and interdependent mandates, principles, and guidelines.