Application of Machine Learning in Raw Material Classification

Using Hyperspectral Data and ML Algorithms for Mineral Resource Mapping

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Study Area and Topics of Interest [1]

Study Area: Sardinia

Focus on Minerals: Cobalt and Others

- **Cobalt:**
  - Importance in battery industry and green technology
- **Other Minerals:**
  - Copper, gold, lithium, etc.

Traditional Methods vs. Machine Learning [2]

- **Traditional Methods:**
  - Linear Spectral Mixture Analysis, Principal Components Analysis,Fractional Abundance Maps
  - Limited accuracy and processing time
- **Machine Learning:**
  - Automated classification
  - Higher accuracy and ability to handle large datasets
  - Identification of complex patterns not evident manually

Mapping Process:

1. Data preprocessing
2. Model training and validation
3. Generation of mineral maps

Hyperspectral Data and Machine Learning Algorithms [3][4][5]

Classical Algorithms:

- **Spectral Unmixing:**
  - Regression problem
  - Model interpretability

ML Algorithms (Supervised Classification):

- **Random Forest:**
  - Ideal for large datasets
  - High precision
  - Black-box model
- **K-Nearest Neighbors (KNN):**
  - Suitable for smaller datasets
  - Better explainability

- **Regression problem on continuous percentages**
  - Small datasets
  - Model simplicity
  - Careful parameter selection
  - Suitable for accelerating analysis without losing in precision

Thesis Work Contribution

Work:

- Application of ML techniques to mineral mapping, studying a regression problem on continuous percentages

Expected Added Value:

- Improved accuracy over traditional methods
- Identification of the significant parameters

Impact on Raw Materials Project:

- Decision-making support for specific themes
- Facilitation of sustainable resource management

Future Developments

Next Steps:

- Implementation and testing of the proposed model
- Development of practical applications

Thanks for your attention

Questions?

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