

# Geochemical Atlas of the Kingdom of Saudi Arabia

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Regional stream-sediments geochemical survey metadata

## **1 INTRODUCTION**

The metadata of the Geochemical Atlas of the Kingdom of Saudi Arabia are structured information that describe and explain data set of the several regional geochemical surveys conducted over the Arabian Shield since 2001.

## **2 REFERENCE DATE**

2001-2021

## **3 ABSTRACT**

The reconnaissance-scale stream-sediments geochemical surveys is designed to promote the effective use of exploration geochemistry in the Arabian Shield. The primary purpose of the survey is to systematically sample stream sediments at a density of one sample per 25 km<sup>2</sup>, determine the concentrations of elements through ICP and AAS techniques, and present the spatial variations of the elements as geochemical maps of various styles. The ultimate goal behind the survey is to provide further data for the Geochemical Atlas of the Kingdom of Saudi Arabia that can be used to support mineral exploration, environmental monitoring, geological mapping, and land-use decision-making. Sample preparation and chemical analysis were carried out at the Geological and Chemical Laboratories of the Saudi Geological Survey (SGS) in Jiddah. The analytical data are stored in the Saudi Geological Survey Geosciences Database. After intensive QA/QC investigation, the analytical data were evaluated through the application of various single-and multi-element statistical methods, creation of geochemical maps, and preparation of technical reports.

## **4 PURPOSE**

The geochemical survey data provides a baseline that can be used to:

- Systematically develop mineral resources through the production of various geochemical maps and preparation of complementary research and orientation studies to enhance the effective use of geochemistry in metal exploration.
- The data can be processed statistically and can be used to derive geochemical analysis maps and are suitable for regional examination (spatial analysis), such as the generation and modelling of multielement geochemical maps.

- Support environmental sustainability in Saudi Arabia and develop it. The database and the geochemical maps provide the government and the private sector with preliminary information that helps them make appropriate decisions when planning cities, villages and agricultural areas by studying the distribution of some of the environmental relevant elements such as arsenic, mercury, lead, radioactive elements etc. that can be harmful to the ecosystem and human health.
- Prioritize the search for contaminated land and their development and mitigation.
- Determine and maintain geochemical factors that affect the sustainability of biodiversity
- Improve our understanding of links between the environment and potential impacts on health

## 5 SAMPLING STRATEGY

The reconnaissance geochemical survey of each  $1\frac{1}{2}^{\circ} \times 1^{\circ}$  quadrangle involved the collection of stream sediments using color-composite ETM+ Landsat images (bands 7, 4, 2) in combination with georeferenced topographic sheets of the area as base maps. The  $1\frac{1}{2}^{\circ} \times 1^{\circ}$  quadrangle is equivalent to twenty-four geo-referenced 1:50,000-scale topographic map sheets with a size of about 25 km x 25 km (15' x 15'). To obtain an average sampling density of one sample per 25 km<sup>2</sup>, each 1:50,000-scale geo-referenced topographic sheet was overlain with a 5x5 cell grid in which each cell represented 3' of longitude and 3' of latitude (i. e. 5 km x 5 km). A sampling site within each grid cell was then pre-selected from a second- or third-order stream to represent the largest possible drainage area. All samplers used the Geochemical Atlas Protocol of the Kingdom of Saudi Arabia in order to ensure compatibility of the sampling methodology. The final site selection was made in the field based on the feasibility of collecting suitable sample material, avoiding sampling of stream sediments that are observed to be derived directly from a known mineral occurrence or ancient mining, with the selected location being stored in the GPS. The stream sediments samples were taken from the active streambed, and involve obtaining approximately 5 kg of sediment by digging a small pit to a depth of about 30 cm and then dry-sieving the material through 2 mm (10 mesh) non-metallic screens in the field. At each sample site, field notes such as sample

number, geospatial coordinate, sample color, possibility of contamination etc. were recorded.

## **6 SAMPLE PREPARATION**

Following the Geochemical Atlas Protocol of the Kingdom of Saudi Arabia, sample preparation and chemical analysis were carried out at the Geological and Chemical Laboratories of the Saudi Geological Survey (SGS) in Jiddah. Each field sediment sample was split, with one-half (about 2.5 kg) for archiving for future reference, and the other half dry-sieved to obtain a size fraction between 2 and 0.177 mm (10 and 80 mesh), which provides optimal contrast between anomalous and background responses. Each sieved sample was then pulverized to  $-100\ \mu\text{m}$ . During the sample preparation phase and prior to chemical laboratory submission,  $\sim 4\%$  analytical duplicates and  $\sim 4\%$  replicates (in-house standard) are prepared from the pulverized samples for quality-assurance purposes, which were introduced at regular intervals into the analytical streams of field samples prior to analysis so that they were blind to the laboratory.

## **7 CHEMICAL ANALYSIS PROCEDURE**

Multielement analysis was carried out in a 1-gram aliquot following HF/HClO<sub>4</sub>/HCl/HNO<sub>3</sub> digestion. Determination of the major elements SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, MnO, MgO, CaO, Na<sub>2</sub>O, K<sub>2</sub>O, TiO<sub>2</sub>, P<sub>2</sub>O<sub>5</sub>, and SO<sub>3</sub><sup>2-</sup> (reported in weight per cent [wt.%]); and the trace elements As, Ba, Be, Bi, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Ga, Gd, Ge, Hf, Ho, La, Li, Lu, Mo, Nb, Nd, Ni, Pr, Sb, Sc, Sm, Sn, Sr, Ta, Tb, Th, Tm, U, V, W, Y, Yb, Zn, and Zr (reported in parts per million [ppm]) was performed by using Inductively-Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Determination of the trace elements Ag and Pb (in ppm), and Au (in ppb) was performed by using Atomic Absorption Spectrometry (AAS). Loss on ignition (LOI) was determined (in wt.%), as a proxy for estimating the organic matter content of the sample, by heating the sample in a furnace at 500° C for 1 hour.

## **8 DATA INTERPRETATION**

The analytical data were evaluated through the application of various single-and multi-element statistical methods, creation of single-and multi-element geochemical maps using Excel and Surfer software as tools, and writing technical report.

## **9 FUNDING SOURCE**

The Geochemical Atlas of the Kingdom of Saudi Arabia Program is funded by the Government of Saudi Arabia.

## **10 KEYWORDS**

Geochemical atlas, geochemical survey; geochemistry; mineral exploration, stream sediments, Arabian Shield.

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