GEOCHEMICAL SURVEY IN SOUTHERN PROVINCES OF MOROCCO

Overview :

The geochemical surveys (soil and heavy mineral) have been conducted in three times by ONHYM in the southern Provinces of Morocco. These surveys helped to cover a total area of 13,500 km². With over 16,000 soil samples and 2600 heavy mineral samples . The obtained results helped to define the spatial repartition of anomalous concentration related to multiple elements, probably relation to mineral deposits.

	First Campaign	Second Campaign	Third Campaign
Date	2005-2007	2009-2013	2014-2016
Covered areas (Km^2)	5 436	5 049	3 100
Soil samples	10 004	10 000	6 380
Heavy mineral samples	1 019	1 000	643
Analyzed elements in soil samples	Ag, Si, Ca, As, Au, Ba, Be, Bi, Cd, Ce, Co, Cr, Cu, Fe, Na, Al, Hg, K, Li, Mg, Mn, Mo, Nb, Ta, Ni, P, Pb, Sb, Sc, Sn, Sr, Te, Th, Ti, U, V, W, Y, Zn, Zr, Pt, Pd and Rh		
Analyzed elements in Heavy minerals samples	Au, Ag, As, Ba, Be, Bi, Ce, Cu, Hg, Mo, Nb, Ta, Pb, Sn, Ti, W, Zn, Zr, Pt, Pd and Rh		

Geological setting and location:

The covered area is located about 150 km southeast of Dakhla. It is joined by several tracks emanating from «Dakhla - Mhairiz» or «Dakhla – Aousserd» roads. The geological formations in the Southern Provinces comprise two separate blocks : **(i)** The Eastern stable Archean autochthonous rock part of the West African Craton. **(ii)** A Western block formed by allochthonous epizonal, mesozonal or catazonales overthrust piled up on each other during the Hercynian structure. The age of geological formations is from Archean to Paleozoic. The two units described above are contacted through the allochthonous detrital formations from Ordovician, Silurian and Devonian.

Location and geology of Geochemical surveys

First campaign		Second campaign		Third campaign	
G1	Ni, Cr, Co, Mg ± V ± Ti ± Fe ± Pt ± Pd ± Au ± Cu	G1	U, Th, Ce, Ta, Nb, Ba ± Ag ± Sn ± W± Pb ± As ± Pt ± K	G1	Co, Mg, Cu, Fe, V ± Cr ± Ni ± Zn
G2	Ni, Cr, Co, Cu, Pt, Pd, Rh, Mg ±Te ± Ag ± Sr ± Fe ± Na ± Au	G2	Ni, Cr, Co, Mg ± V ± Ti ± Fe ± Pt ± Pd ± Au ± Cu ± Ag	G2	Ni, Cr, Co ± Cu ± V ± Fe ± Mg
G3	Ni, Cr, Co, Mg, Pt, Pd, Rh, Au ± Cu± Ti ± Sc ± U ± Te	G3	Co, Fe, Sc ± Cu ±Ag ± Ti ± V ± Mg± K	G3	U, Th, Ce ± Ba ± Na ± K ± Be ± Y ±Sn± Pb ± Nb ± As
G4	Pb, Zn, As, ± Ag ± Cd ± Sn	G4	U, Th, Y ± Ce ± Pb ± Zn	G4	Pb, Zn, As ± Y ± Th ± U ± K ± Li ± Be± Sn ± Ce ± Nb ± Cr ± Co
G5	U, Th, Ce, Ta, Nb, Ba, ± Ag ± Sn ± W ± Pb ± As ± Pt ± K	G5	W, Sb, K ± Ag ± Cd ± Sn	G5	Th, Ce, Nb ± Y ± Sn ± Be ± Pb ± Nb± As ± K
G6	U, Th, Zr, ± Y ± Ce ± Pb ± K			G6	Cr, Co, Ce, Cu ± Sn ± Te ± Nb ± Bi ± Ba ± Sr ± W
G7	Cu, Co, Fe, V ± Ti ± Sc ± Mg ± Na ± Zn				

Geochemical associations defined by both geochemical campaigns

Achieved Works and results :

Orientation test: The works started with orientation survey to define the most representative fraction size for soil samples, which gives the best contrast between the values of geochemical background and geochemically anomalous values. The survey showed that the fraction <250 microns gives the best contrast between the geochemical background and anomalous values. For heavy mineral samples, the objective is focused on defining the mineral associations represented in the sector.

Geochemical survey : The campaigns have been conducted in Sdar, Ma'talla, Ouday Çfa, Mzayzat As-Sakkoum, Al Aggaya, Set Al Ayn Al Bayda, Lahjayra Al Bayda, Bir Gandouz, Imlily, Al Faj and Madnat Aghracha topographic maps at a scale of 1:100 000.

Data processing and results: All campaigns results are recorded in a database. The analytical data were subjected to statistical processing (basic statistics, factor analysis and correlation matrices). In addition, mono-elementary and multi-elementary soil and stream sediment geochemical maps were developed. The results of the various geochemical surveys are available in digital and paper formats and are presented in the

Data base : ONHYM handles a very large amount of data relates to the geochemical campaigns. This data base are managed by the Mining Exploration Department. The data, reports, atlases and maps relating to the various geochemical surveys are made available to foreign companies in the framework of an agreement, agreement or cooperation contract.

Outcomes & perspectives:

Research prospects for in the areas covered by geochemical campaigns are very promising for the following reasons:

- Several mono and multi-element geochemical anomalies have been identified and need to be followed up;
- Several mining occurrences were discovered following the geological follow up and are currently under detailed studies.

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form of explanatory notes, geochemical atlas, Access databases, ARCGIS and MAPINFO project.

The interpretation of the geochemical anomalies obtained in relation to the geological and tectonic context of the sector made it possible to establish a synthesis of the results, for each of the campaigns, highlighting the different associations of elements with geochemical affinity. Thus, various associations characterizing the different geological contexts have been defined for the soil and the alluvial for each of the campaigns. The anomalous areas highlighted have been prioritized and are targets for miner research. The table showed below, summarizes the different associations defined for the soil.

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