Beitr. Geol. Thüringen	N.F. **21**	211 - 220, 3 Abb.	Jena 2014

A Summary of Joint Yemeni – German Geological Expeditions in 1976 – 1979 and 1982 – 1987

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Stichworte: Jemenitisches Küstengebirge/Golf von Aden, Jawl Plateau/Hadramaut-Region, Stratigraphie des proterozoischen Grundgebirges, mesozoisch-känozoische Abfolgen des Plattform- und Küstenbereiches, Geologische Karte 1:100.000, Mineralisationskarte 1:200.000, Strukturkarte 1:500.000

Zusammenfassung

Zusammenfassender Bericht über die Ergebnisse von zwei deutschen Geologenexpeditionen im Südjemen 1976-1979 und 1982-1987

Die Ergebnisse von zwei deutschen Geologenexpeditionen im Südjemen (ehem. Volksrepublik Jemen), durchgeführt in zwei Etappen 1976 - 1979 und 1982 – 1987, werden in kurzer Form vorgestellt. Dem Gesamtprojekt liegen zwei umfassende Vereinbarungen zwischen dem „Ministry of Energy and Minerals“ (Aden) und dem früheren „Kombinat Geologische Forschung und Erkundung“ (Halle) zugrunde. Das Gesamtprogramm umfasst geologische Kartierungs-, Such- und Erkundungsarbeiten in der Küstenregion und im Küstengebirge des Adengolfes (Shabwa-Governorat) und weiter in nördlicher Erstreckung bis zum Jawl-Plateau der Hadramaut-Region. Die Untersuchungen umffassten eine Fläche von mehr als 27.000 km².

Beteiligt an den Kartierungs- und Erkundungsarbeiten waren im Jahresschnitt jeweils 17 bis 20 deutsche Geologen, Mineralogen und Geografen unter ständiger Mitwirkung von zwei bis vier jemenitischen Geologen sowie jemenitischen Hilfskräften und Kraftfahrern. Im Ergebnis beider Expeditionen wurden zwei mehrbändige Ergebnisberichte (s. u. Abschnitt Literatur) und Geologische Karten im Maßstab 1:200.000 (als Reconnaisance Mapping der ersten Expedition) sowie ein umfassendes Kartenwerk des Gesamtgebietes, im Einzelnen

- Geologische Karten im Maßstab 1:100.00 (16 Blätter, Abb. 2)
- Mineralisationskarten 1:200.000
- Geomorphologische Karten 1:200.000 und
- eine Strukturkarte 1:500.000 (Abb. 3)

als Druckwerk dem jemenitischen Vertragspartner übergeben Im Umfeld von mineralhöffigen Gebieten wurden Spezialprospektionen (1:5.000 – 1:25.000) zur Erfassung des metallogenetischen Potenzials unternommen.

Zu den bedeutsamsten Ergebnissen gehören die Lokalisierung von „Uranmineralisationführenden Sandsteinen“ und die Erkundung von „Anomalien mit Platinkonzentrationen in ultramafischen Gesteinsabfolgen“ des Grundgebirges. Weiter beachtenswert sind die Funde von „karbonatgebundenen Zinkmineralisationen“ im jurassischen und paleozänen Deckgebirge.

1. General

In 1976, the former Peoples Democratic Republic of Yemen and the former German Democratic Republic have launched a long lasting and fruitful co-operation in the field of geological mapping and mineral exploration. The comprehensive Surveying Program has been agreed between the Deputy Minister of Energy and Minerals at Aden, Mr. RASHID AL KAFF, and the Director General of the "Kombinat Geologische Forschung und Erkundung" Halle, Mr. REINHOLD.

The area of investigation is covering more than 27.000 km² of the southern Coastal Mountains in the Shabwa and Hadramout Governorats (Fig. 1).Geologically,the surveying area covers the southern part of the Ramlat Sabatayn structure and its neighbouring uplifts to the South Hadramaut Arch in the east. Thus, it is located in the heavily faulted transition zone between the Proterozoic Basement outcrops of the southwest part of (South-) Yemen and its Meso-Cenozoic Platform successions occupying the eastern part.

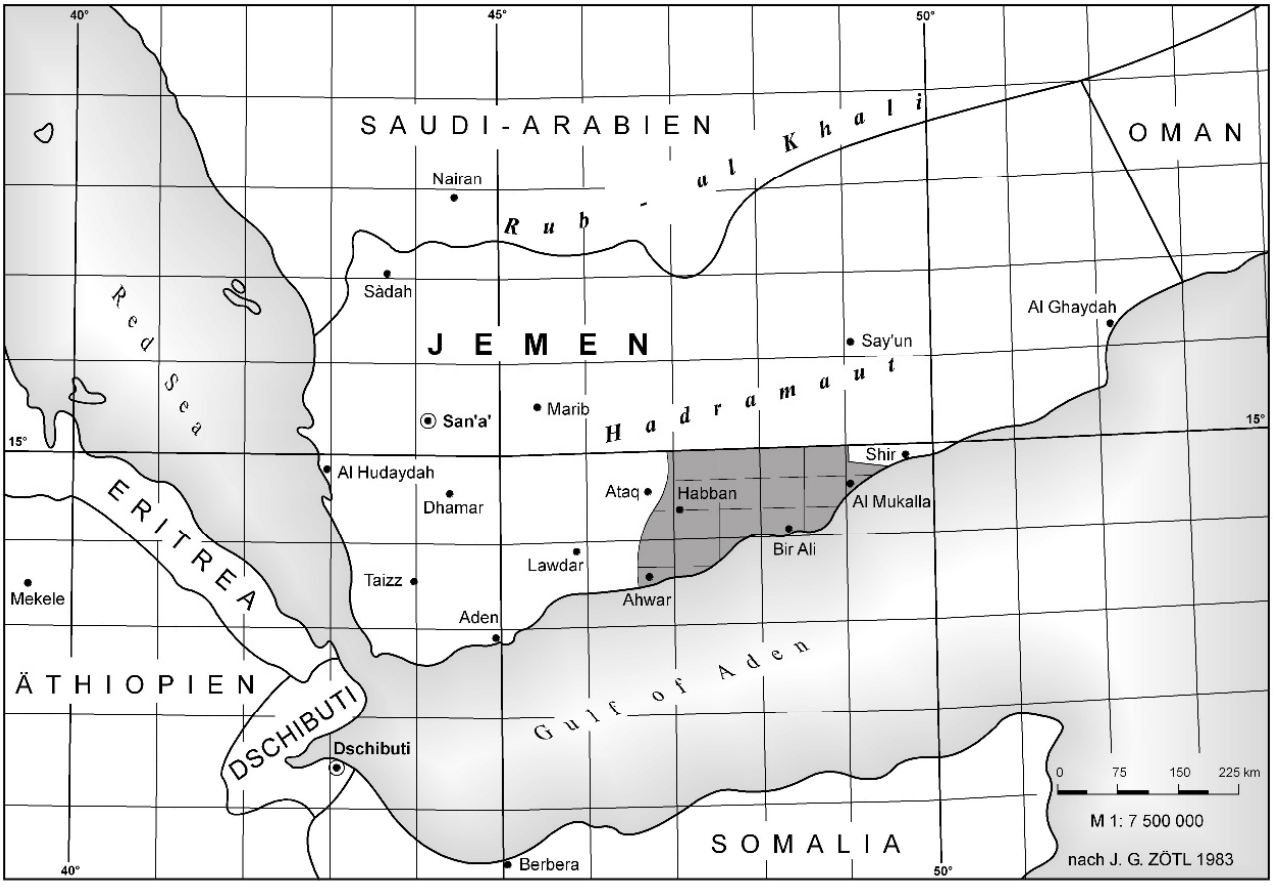

Fig. 1: Surveying area of the first and second expedition with grid of the Topographic Map 1:100.000

1987 the extensive Surveying Program was completed with the Final Report (Volumes I-V) including 16 map-sheets of the printed Geological Map on scale 1: 100 000 and several thematic maps, among others the Map of Mineralisation 1: 200 000.

In the course of investigations a wide variety of opportunities for mineral exploration are discovered, including Uranium, Gold, Zinc, Lead, Platinum, Barite, Fluorite, and construction minerals (ANDREAS et al. 2010).

2. The First Expedition 1976 – 1979 (ANDREAS et al. 1979)

Mapping activities were launched 1976 by a reonnaissance – survey Project which extents over an area of approx. 16 000 km² between Ahwar/Mahfid in the west and Bir Ali in the east. During the 3 years Project a Geological Map on scale 1:200.000 was provided, completed by a number of thematic geochemical and detailed prospecting maps. The comprehensive work was executed by a team of about 30 German and Yemeni geoscientists and a supporting staff. Owing to failing of suitable topographic base maps at that time, great efforts were taken upon the creation of an aerial-photograph based topographic map. Field mapping was headed by remote sensing studies (aerial photographs) in order to prepare a provisional geological map.

The Basement complex was completely comprehended by traverse mapping, yet less dense through reconnaissance survey within hardly accessible terrain. Although the unfavourable and difficult terrain a most remarkable and detailed lithostratigraphic division of the Basement as well a differentiated representation of magmatic rocks could be submitted. Within the succession of Platform deposits the network of detailed investigations is less dense, and aerial–photo interpretation was used to complete reconnaissance terrain mapping. Special attention was applied to mapping of the near – coast region covered by Neogene and Quaternary riftogenic deposits. Field work activities were accompanied with comprehensive sampling as well an analytical program which includes thin sections, chemical-, petrographic– and mineralogical analyses and paleontological studies.

Finally a detailed lithostratigraphic legend was created, considering metamorphic basement rocks, the magmatites, as well platform and riftogenic sedimentary and volcanic Formations. Mineral prospecting activities were directed on an implementation of regional stream – sediment and heavy –mineral prospection, and on detailed investigations of two mineral occurrences:

- hydrothermal fluorite – barite veins of the Irqha area, and
- magnesites of Ahwarid.

3. The Second Expedition 1982 – 1987 (SCHRAMM et al. 1987)

In 1982 the Second Joint Yemeni – German Expedition was launched to improve and complete the findings of the preceding expedition. The investigation area evidently was enlarged to the east and north up to the Mukalla-region and the Jawl-Plateau.

Moreover, the recently investigation program is related with the so-called **Integrated Geological Survey (IGS)** comprising a total area of approx. 90 000km² in the western part

of South Yemen [authorized of Czech and Russian teams]. It corresponds with the items and principles of the IGS as well with the conclusions of IGS-consulting meetings between the Russian, the Czech and the German missions held in Aden under the leadership of the Board of Petroleum and Minerals. Consequently, our mapping area expanded up to 27.000 km² and was adjusted to the grids of the newly available Topographic Map 1:100.000 (Fig. 1). Taking into account further parts of the first expedition the entire territory runs up to nearly 30.000 km².

During the 4 to 5 years Project a comprehensive set of geoscientific maps has been created:

- Geological Maps 1:100 000 (Fig. 2), including general legend and cross sections (16 sheets)
- Mineral Distribution Map 1:200.000, including metallogenetic scheme (2 sheets)
- Geochemical Map 1:200.000 (2 sheets)
- Geomorphologic Map 1:200.000 (2 sheets)
- Tectonic Map 1:500.000 (Fig. 3), including cross sections and structural provinces

The whole work was executed by a team as many as 40 German and Yemeni geoscientists and the supporting staff.

4. Geological mapping activities

The investigated area of the second expedition comprises Platform sediments (14.500 km²), Basement rocks (> 3.500 km²) and riftogenic Neogene – Quaternary sedimentary and volcanic rocks (> 8.000 km²). Mapping was executed as a combination of traverse field mapping completed by remote-sensing methods using aerial-photographs.

Naturally, within areas with outcrops of Basement a dense traverse network was required to explore the complex geological structure. Within Platform occurrences a combination of reference profile descriptions, field traversing and remote-sensing methods has been applied. In total 1390 traverses with more than 12 600 route-km and more than 90.000 m of reference sections are documented.

Basically all geological formations and rocks are characterized by detailed chemical-, petrographic- and mineralogical laboratory-examinations. Additionally, many sedimentary deposits are subject of paleontological studies. All geological and thematic maps are compiled as individual documents with their legends and cross sections. Maps are offset printed in 500 number of copies.

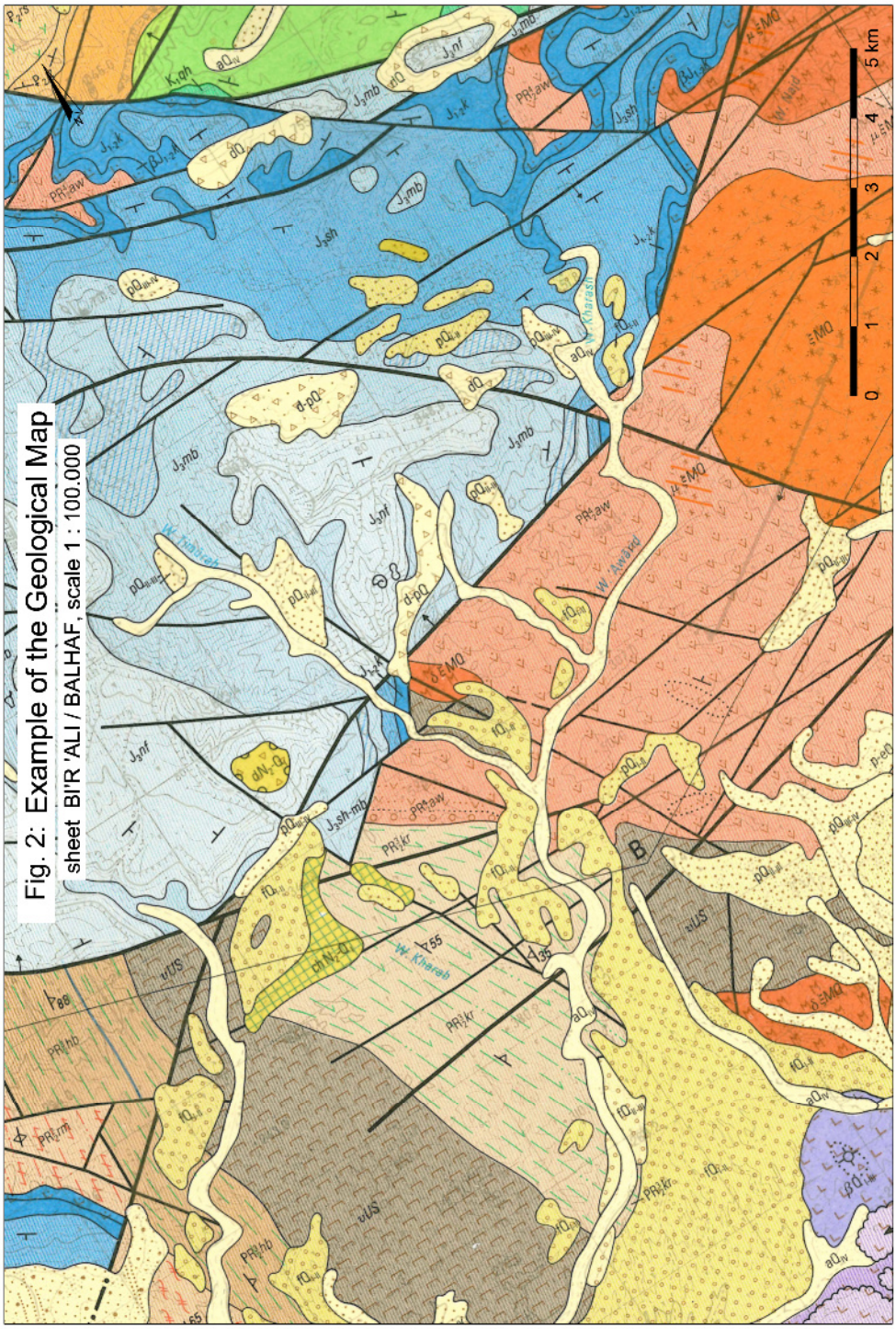

Fig. 2: Detail (see Fig. 3) of the Geological Map 1:100.000 (sheet D-39-61 BirAli / Balhaf) Legend see Fig. 2b

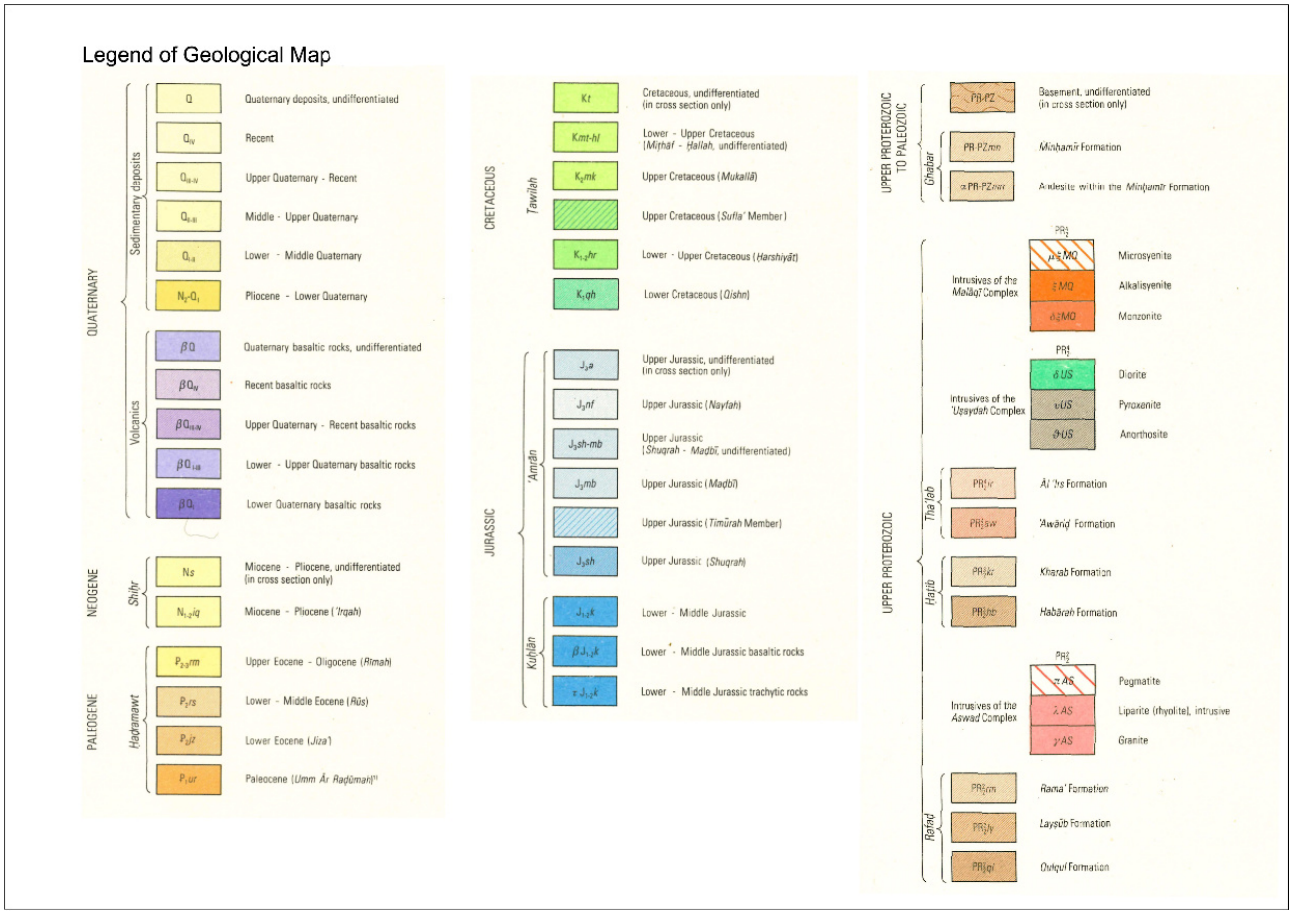

Fig. 2b: Legend of Fig. 2

5. Mineral prospecting

The investigated area is located within a highly promising metallogenetic position covering the heavily faulted transition-zone between the Proterozoic Basement of southwest Yemen and the Meso-Cenozoic Platform formations in the east part.

Great effort was applied on the determination of the mineral variety at the geological most promising ares. Considering the level of knowledge and the very different geological setting a combination of heavy-mineral-,lithogeochemical- and remote-sensing-methods has been employed for.

Main investigations were directed towards the exploration of metals as Au, Ag, Cu, Sn, W, Pt, Ti; further on a wide variety of non-metallic / construction minerals (limestone, gypsum, glass sand, clay, cement raw –materials, decoration stone and others).

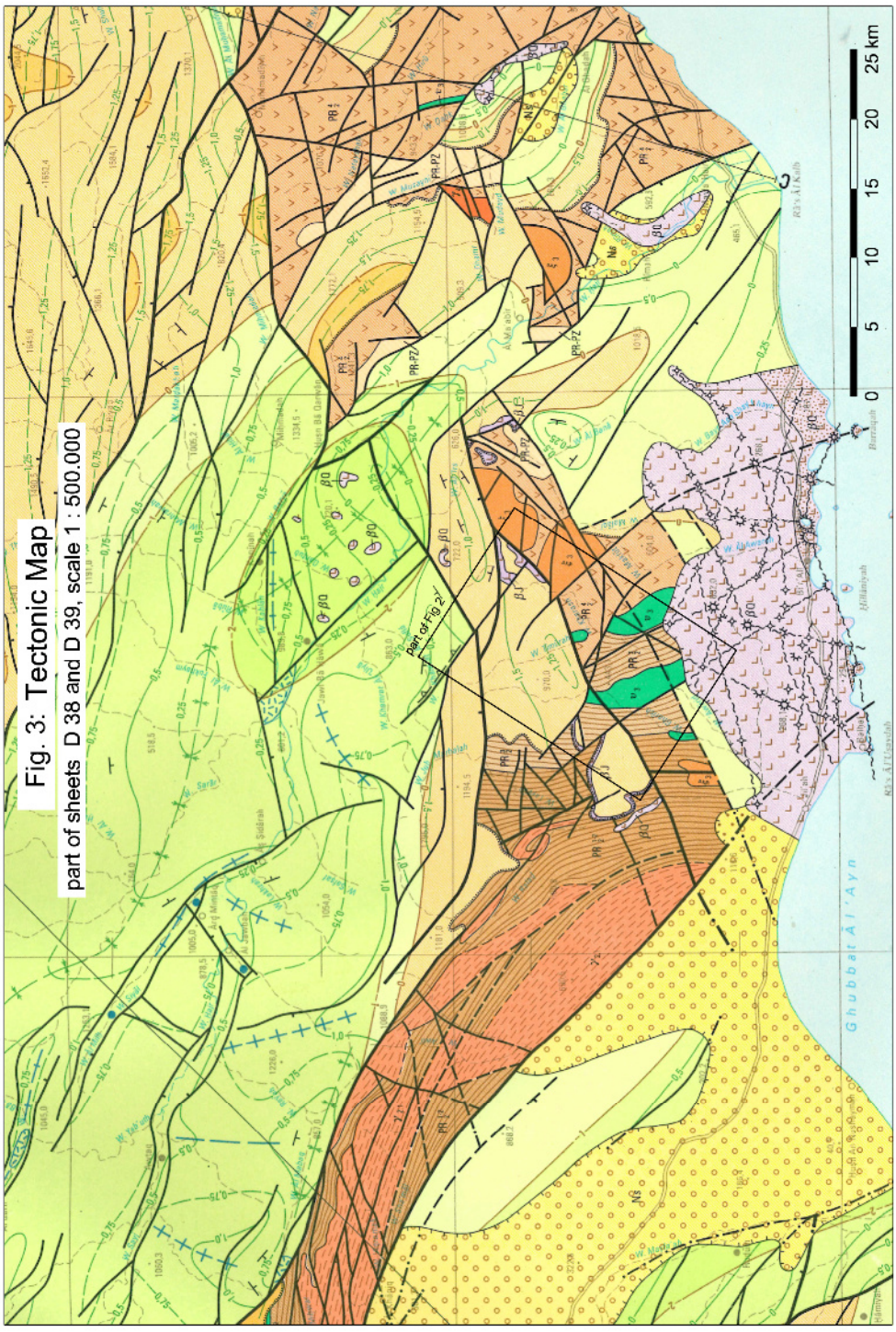

Fig. 3: Tectonic Map 1:100.000 (parts of sheets D 38 and D 39) Legend see Fig. 3b, square shows position of Fig. 2

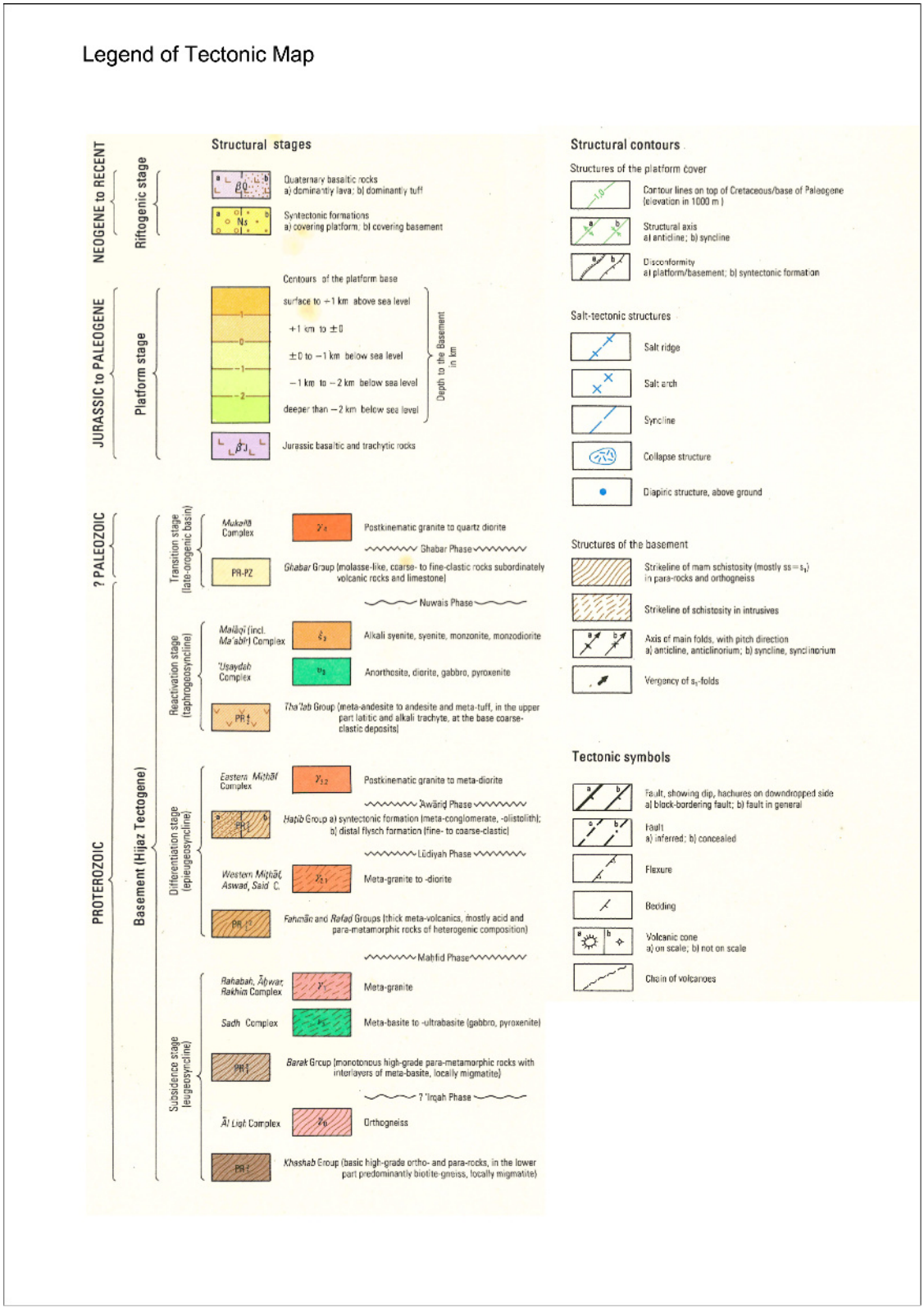

Fig 3b: Legend of Fig. 3

The regional geochemical exploration contains stream-sediment and heavy-mineral sampling; the sampling density varies from: 1 sample taken per 1 to 2 km² of Basement rocks, up to 1 sample taken per 20 km² of Platform sediments. All gossaniferous formations and otherwise promising deposits are discovered by hard rock sampling, in order to determine the geochemical specialisation and to investigate their mineral potential, mainly Au, Ag and PGE. All selected samples are analysed on 20 chemical elements, f.e. Cu, Pb, Zn, Sn, Nb, B, Cr, Ti, Be, Li, Mo, W, As, Ag.

Within 20 areas selected in the course of regional geochemical prospecting and likewise to an airborne geophysical survey (GRIGORIEW et al. 1979) detailed follow – up studies are executed to clarify their mineral prosperity. Herewith more detailed investigations on scale 1:5.000 up to 1:25.000, implying field mapping, hard rock sampling, and supported by aerial-photo interpretation, are applied.

As important discoveries of the Project are considered following types of mineralisation:

- Increased Pt-concentrations within several ultramafic Basement rocks,
- Vein-, shear-zone and breccias hosted Au-mineralisations found within Upper Proterozoic metavolcanics
- U-bearing sandstone of the Taweelah Formation
- Carbonate hosted Zn-mineralisations in Jurassic and Paleocene limestones
- Barite veins in large hosted fault systems of Platform chains

The obtained results of all mineral exploration activities are finally used for compilation of the Map of Mineral Distribution.

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Autorenanschrift

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