China-Arab States Cooperation on Geological Survey (2017)

China Geological Survey,

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Table of Contents

The extensive China-Arab states (hereinafter referred to as China-Arab) cooperation on geological survey started in the 1970s when joint hydrogeological survey was conducted to help local people to gain access to drinking water. In the 21st century, China-Arab cooperation on geological survey entered into a new historical development period. China established extensive China-Arab geoscientific cooperation network and platform, cultivated a number of administrative and technical staff for the mining departments of Arab states, thus building up the capacity for geological survey in Arab states. Geological survey institutions from China and a number of Arab states have jointly carried out fundamental geological work, for instance, cooperation projects in geological mapping and geochemical mapping, which enhanced the level of geological work in Arab states and played a positive role in improving the mineral exploration and investment environment in Arab states.

I. China-Arab Geological Survey Cooperation Network Has Been Initially Established Based on a Demand-Driven Approach

China and most Arab states are developing countries, and they are confronted with common development issues. Meanwhile, China and Arab states have rich natural resources that are complementary to each other. As a result, the need of cooperation on geological survey between the two sides is very strong.

So far, China has established bilateral cooperative relations with three Arab states in geological survey, including Morocco, Sudan and Saudi Arabia, signed six memorandums of understanding or project cooperation agreements and implemented seven cooperation projects thereunder.

Diverse multilateral cooperation platforms have been established to boost pragmatic cooperation with Arab states in multiple fields. Making full use of the cooperation platforms such as China Mining, the UNESCO International Research Center on Karst, the UNESCO International Center on Global-Scale Geochemistry, the Global Geoparks Network Office etc., China has further promoted its cooperation with Arab states in mining investment, karst environment and climate change, hydrogeological, engineering geological and environmental geological survey, geological mapping, geochemical mapping, geological interpretation of satellite remote sensing, geoheritage and geoparks, leading to an expanded China-Arab cooperation network in geological survey. In addition, China Geological Survey (CGS) has set up North and West Africa Geosciences Center to consolidate the foundation for China-Arab cooperation on geological survey.

II. China-Arab Geological and Geochemical Mapping Cooperation Has Expanded with the Emphasis on Fundamental Geological Survey

In view of the weak basic geological work in Arab states, to solve the problems of resources, environment and people's livelihood, it is highly important to consolidate the basic geological survey, enlarge the scale of geological survey and provide basic geological information services. In recent years, CGS has jointly conducted 1∶50,000 to 1∶250,000 scaled geological and geochemical mapping successively with the geological survey institutions in Morocco, Sudan and other countries, completed an area of 6493 km^2 in geological mapping, an area of 14440 km^2 in geochemical mapping and an area of 26912 km^2 in remote sensing interpretation at various scales (Table 1).

Table 1 Fact Sheet of China-Arab Geological-geochemical Mapping Cooperation Projects Since 2006

Cooperative countries	Duration	location	Project details		
			description	Scale	Area (km^2)
Morocco	2014-2015	Meknès-Tfilalt	Geochemical mapping	1:100,000	7947
	2015-present day	West Atlas	Geological mapping	1:50,000	2688
			Geochemical mapping	1:50,000	2688
			Remote sensing interpretation	1:50,000	2000
Sudan	2012-2017	Red Sea State in NE Sudan	Geological mapping	1:250,000	3805

			Geochemical mapping	1:250,000	3805
			Remote sensing interpretation	1:250,000	24912

CGS compiled nearly 500 special geological and geochemical maps at various scales and delineated over 300 Cu, Au, Cr and PGE anomalies, including two Au anomalies, one Cu anomaly, and two Fe anomalies. The above work has improved the basic geological work in the collaborating countries, enhanced their ability to attract mining investment, and provided basic geological data for their natural resources and environmental sustainability.

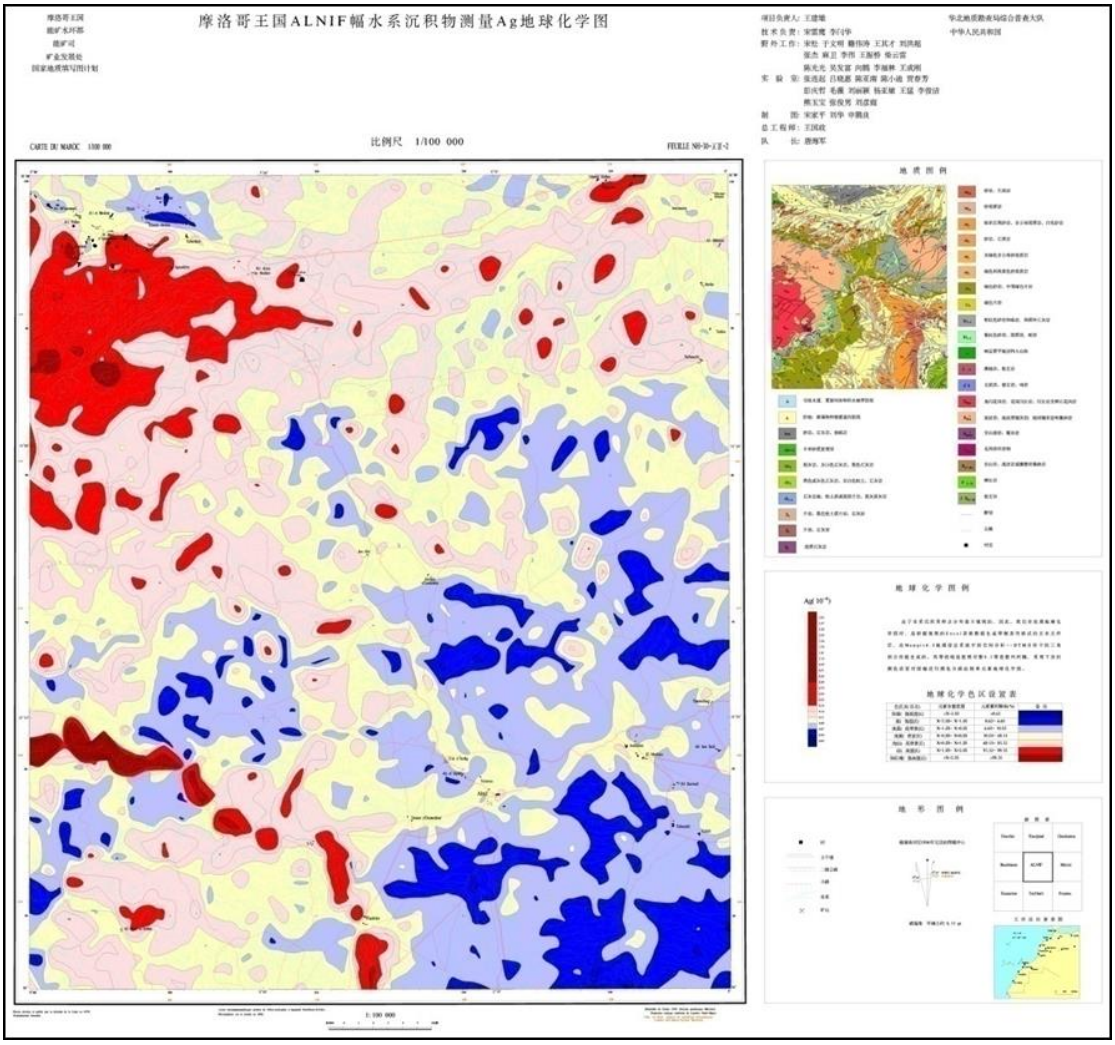

Fig. 1 Geochemical Map of Ag Element in Morocco (Alnif)

III. China-Arab Geoscience Research Cooperation Has Yielded Initial Results Led by Advanced Science and Technology

Constrained by the limited human, technical and capital resources, much of the Arab states has carried out little geoscientific research in many fields, such as the tectonic evolution of sedimentary basin and oil and gas accumulation, tectonics-magmatic events and mineralization, leaving vast potential for China-Arab cooperation in the field of geoscientific research.

In cooperation with geological survey institutions in Sudan and other countries, CGS summed up the metallogenic geological background of the research area, proposed that the Neoproterozoic Pan-African movement laid the tectonic pattern of the Northeast Africa, and divided the tectonic units in the Northeast Africa. Based on the research of mineral resources and metallogenic characteristics in the Northeast Africa, CGS proposed that the predominant minerals in the Northeast Africa include gold, copper, PGE and rare earth element minerals, divided the region into 12 grade-Ⅲ metallogenic belts, summarized the regional ore-controlling conditions and the metallogenic rules in the major metallogenic belts, and analyzed the metallogenic effects. Based on the grade-Ⅲ metallogenic units, 15 metallogenic prospective areas were delineated.

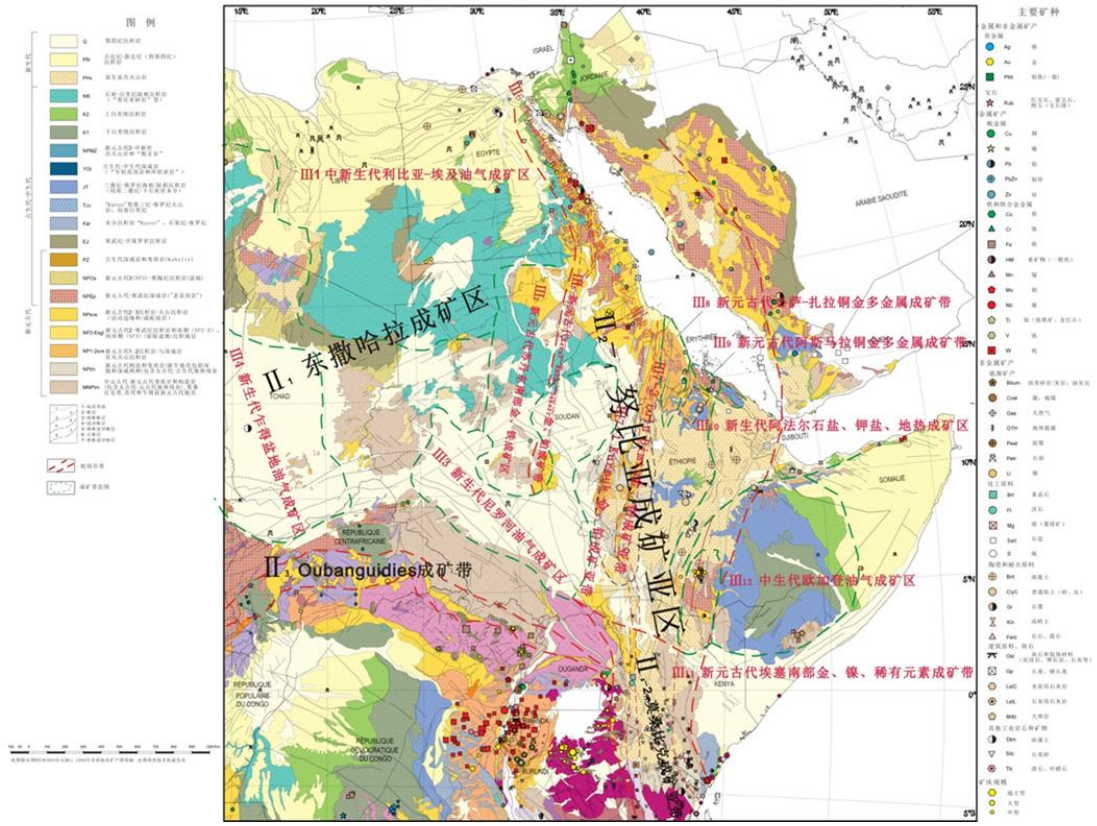

Fig. 2 Initial Zoning Map of Metallogenic Belts in the Northeast Africa

Initial achievements have been made in the metallogenic research in the Arab region. The geological map, mineral distribution map, tectonic magmatic rock map, and the zoning maps of metallogenic belts and metallogenic prospective areas in the Northeast Africa at the scale of 1:2,500,000 were compiled, and the remote sensing image map of the Northeast Africa was completed. The database of mineral sites in Sudan and other countries and the database of mineral sites in the Northeast Africa were established. Research indicates highly rich mineral resources, superior metallogenic geology and immerse mineral resource potentials in the Arab region. Predominant minerals include gold, lead, zinc, iron,

chromium, phosphorus, uranium and petroleum, among which petroleum resources are particularly worthy of attention.

Table 2 Summary List of Predominant Mineral Resources in the Arab region

No.	mineral	Major location	Typical deposit (zone)	Genetic type
1	gold	Sudan	Hassay gold deposit	Hydrothermal type
2	lead, zinc	Morocco	Wade Mokta lead mine	VMS type
3	iron	Morocco, Mauritania, Sudan	Iron deposit in Nazor area, Morocco	contact metasomatic type, BIF type
4	Chromium	Sudan	Chromite deposit in Ingersana Mountain	Related to ultrabasic rocks
5	Phosphorus	Morocco, Algeria	Youssoufia phosphate deposit in Morocco	Sedimentary type
6	uranium	Sudan, Algeria	Abango uranium deposit in Algeria	Granite type
7	petroleum	Libya, Algeria, Egypt, South Sudan, United Arab Emirates, Saudi Arabia, Iraq, Oman, Syria, Yemen, Kuwait, Qatar, Jordan	Ghawar Oilfield, Salah Gasfield	

IV. China-Arab Geological Survey Cooperation on Hydrogeology, Engineering Geology and Environmental Geology Has Gained Remarkable Achievements Targeted at Improving People's Livelihood

Water shortage is a common problem in many Arab states, where drinking water has always remained a challenge for the local residents and constitutes one of the roots for poverty in the Arab region.

Since the 1970s, China has conducted cooperative projects in the fields of hydrogeological survey, water supply investigation and water supply with Algeria, Egypt, Morocco, Sudan and other countries. According to the incomplete statistics, these projects involved the completion of over 300 water supply wells, solving the problem of domestic water for about 2 million people.

Fig. 3 1000m water well on Ghardaia Desert, Algeria

In collaboration with Algeria, we have conducted the hydrogeological survey of urban water supply, drainage and flood control in 11 provinces and municipalities, drilled 224 water supply wells, including 184 domestic water wells, 36 agricultural irrigation wells and 4 industrial

water wells with a total capacity of 36,500m^3/h, solving the problem of supplying water for the 400,000 people's livelihood and economic development.

Fig. 4 Work-site of the municipal pipeline project, Abyei, Sudan

In collaboration with Sudan, we have conducted hydrogeological and environmental survey, water supply investigation and water supply projects in the Baggara Basin in the south of Nyala, the capital city of South Darfur, built two large water sources, three water transmission pipelines, water supply plants and booster pump stations together with the associated water supply, measuring monitoring and maintenance facilities, and drilled 20 water supply wells with a total capacity of 40,000 m^3/d, and supplying water for almost 500,000 residents.

V. China-Arab Geological Survey Talents Cultivation and Personnel Exchange Have Obtained Notable Progress

Talents are the key to improve the geological survey competence. Over the past decade, the Chinese government has conducted human resources exchange and cooperation with six Arab states, including Egypt, Algeria, Mauritania, Morocco, Yemen and Sudan in forms of academic education, short-term seminars, technical training and field technical instructions under the principle of equity, cooperation and mutual benefit.

Fig. 5 Training Course on Geochemical Mapping and Environmental Geochemical Survey in Developing Countries in 2015

We cultivated three postgraduate students in geology for Sudan. We held 13 short-term technical training sessions, involving geological and mineral management, geological survey and mineral resources assessment method and technology, geochemical mapping and environmental geochemical survey technology and other fields,

cultivating over 90 technical staff in mine management and geological survey for Arab states. Through international cooperation projects, we cultivated over 30 professional technical staff in geosciences for Sudan, Morocco and other countries. We also conducted targeted training on GeoExpl (International) software for over 20 geologists to meet the special needs of Morocco for software operation of geological data processing and analysis systems.

Fig. 6 Training for geological management and technical personnel in Morocco

VI. China-Arab Cooperation on Geological Survey Has Broad Prospects for Future Cooperation

In January, 2016, the Chinese government issued its first policy document for Arab states. This document elaborates on the policy measures for China to comprehensively strengthen China-Arab relations in five areas:

politics, investment and trade, social development, personnel and cultural exchanges, peace and security. China-Arab cooperation on geological survey has been conducted for many years, which has already established a friendly and mutually beneficial cooperation basis with broad cooperation prospect. Joint efforts will be made in expediting China-Arab international cooperation on geological survey for mutual benefit with the principles of innovation, opening, interaction and tolerance.

1. Continue to set up and expand China-Arab international cooperation networks and platforms. We will expedite the building of a multilateral international cooperation platform, consolidate the construction of China-Arab international cooperation network, set up China-Arab League multilateral cooperation platform, and sign a number of Memorandum of Understanding and project cooperation agreements in the geoscientific field.

2. Cooperate to compile geological and mineral map series. We will strengthen the basic geological cooperation research between China and Arab states, and work together to compile map series at the scale of 1∶1,000,000 to 1∶2,500,000, including the geotectonic maps, regional geological maps, metallogenic maps, karst distribution maps, geochemical maps and resource and environmental bearing-capacity assessment maps, so as to promote the economic and social development in Arab states.

3. Expedite the building of a China-Arab geosciences information sharing platform. With the principles of co-consulting, co-building and achievement sharing, we will use our established capabilities in big data, cloud technology and other fields of information technology, carry out technical exchange and cooperation on geosciences information sharing, hold specialist forums, symposiums and short-term training on geosciences information sharing, create regional, sub-regional or bilateral geosciences information sharing mechanisms, and facilitate geological and mining information sharing among Arab states.

4. Employ more efforts in stepping up the geological survey capabilities in Arab states. Through long-term human resources training and exchanges, in the coming years, we will gradually increase the number of positions for postgraduate studies and that of short-term seminars and technical training sessions for Arab states as a means to improve the technical competence of geological and mining professionals in Arab states. Meanwhile, by making use of our established capabilities for aero-geophysics, geochemistry, satellite remote sensing, geological information and isotopic dating, we will also initiate methodology and technical cooperation, and jointly build chemical analysis labs and satellite remote sensing application centers.