

Recent advances in the knowledge of geology and mineral resources of Vietnam since 1981

LE THAC XINH and NGUYEN XUAN AN
General Department of Geology
6 Pham NguLao, Hanoi,
Socialist Republic of Vietnam.

Abstract: This review paper gives the major features of geoscience advances not only for the past 3 years but covering also the period further back in order to give a full picture of the development of geology in Vietnam.

REGIONAL GEOLOGY INVESTIGATIONS

In recent years investigation of the regional geology has been conducted mainly in the south e.g. compiling geological and mineral resources maps at scales of 1/500,000 and 1/200,000, since such maps have already been completed before 1975 for the north. Up till now almost the whole northern part of Vietnam has been covered by a geological map at a scale of 1/200,000 with an exception of two sheets located at the northern boundary with the China. Two thirds of the surface of Vietnam are now covered by geological maps at a scale of 1/200,000 and 8 percent covered by geological maps with a scale of 1/50,000. These are for certain areas with mineral potential. In the compilation of the geological maps with the above mentioned scales a series of combination works have been conducted e.g. panning of heavy detrital minerals, metallometric soil sampling of the areas to identify outcrops of mineral resources and assessment of their prospects. As a result a series of maps have been simultaneously compiled for a single area e.g. geological, mineral resources, geomorphological, metallometric, panning and hydrogeological maps.

The most remarkable achievement in regional geology investigation is a newly compiled set of geological maps at a scale of 1/500,000 covering the entire territory. This set of maps sufficiently reflects all the research results of regional geology investigation that have been done in Vietnam for nearly a century. The maps clearly show stratigraphic units in sedimentary basins. The division is based on studies of palaeontological collection material components, thickness of sedimentary and volcano-sedimentary formations and their geological structures. Based on petrochemical, geochemical studies and isotopic age dating analysis, all the intrusive complexes from the age of Archean to Cenozoic as well as metamorphic facies are clearly reflected on the maps. The relations between some igneous complexes and mineralization have been identified based on metallogenic studies. Due to difficulties in printing, the maps are still not available. In the last 3 years some advances in palaeontological and stratigraphic studies have also been made. The Camduong apatite-bearing suite, northern Vietnam, has been dated as Late Proterozoic-Early Cambrian by studies of arcritarcha fossils, sedimentary formations from Cambrian to Devonian have been more precisely divided based on studies of trilobites, graptolites, coelenterates and brachiopods fossil collections. The sedimentary rocks of the Dalat

region, south Vietnam, locally metamorphosed by Mesozoic granites which were believed to be Cambrian, Devonian and Carboniferous, have been redetermined as Jurassic based on studies of cephalopoda fossils collected during mapping work.

EXPLORATION AND PROSPECTING FOR MINERAL RESOURCES

Regional mineral exploration investigations have identified some new areas of tin, molybdenum and gold mineralization. Besides, large reserves of lateritic bauxite have also been discovered. Prospecting for these are being conducted expeditiously.

Exploration and prospection done in the last dacade have determined mineral potential and reserves of major mineral resources such as coal, apatite, iron ores, bauxite, tin copper, chromite, rare earths, lead, zinc, gold and pyrite.

Coal

In Vietnam the main coal bearing formations belong to two periods, Upper Triassic and Neogene. The northeastern coal basin is typical of the earlier period. Prospecting work has determined its structure, reserves and it is now known to be the largest coal mining area in Vietnam. Typical of the second coal-forming period is the brown coal basin beneath the Red River Delta, with some tens of coal seams interbedded within Neogene sediments from a depth of 170 m to over 2000 m. Its reserves are large and problems of exploitation are being studied.

Apatite

Large reserves of apatite in terrigenous and carbonate terrigenous formations of late Proterozoic-Early Cambrian are located along the banks of the upper Red River. In this basin thick apatite seams have been geologically investigated and mined for many years.

Iron ores

The main iron ore deposits are located in the north. Among the various genetic types (e.g. sedimentary, metamorphic, hydrothermal skarn and lateritic), the skarn type of the Mesozoic gives the largest reserves.

Bauxite

Lateritic bauxite have just been discovered and assessed in the south after 1975 and are now under prospecting. It has reserves of several billion tons and is formed within the weathering crust of Neogene-Quaternary basalts. However sedimentary bauxite in the north is hosted in the upper Permian limestone.

Tin

Tin and tungsten mineralizations both in the north and in the south are mainly related to granites of Mesozoic and Cenozoic ages. Mining operations are now mainly concentrated on tin placers. Primary tin deposits are now being prospected in Tam Dao areas, North Vietnam, and some other places.

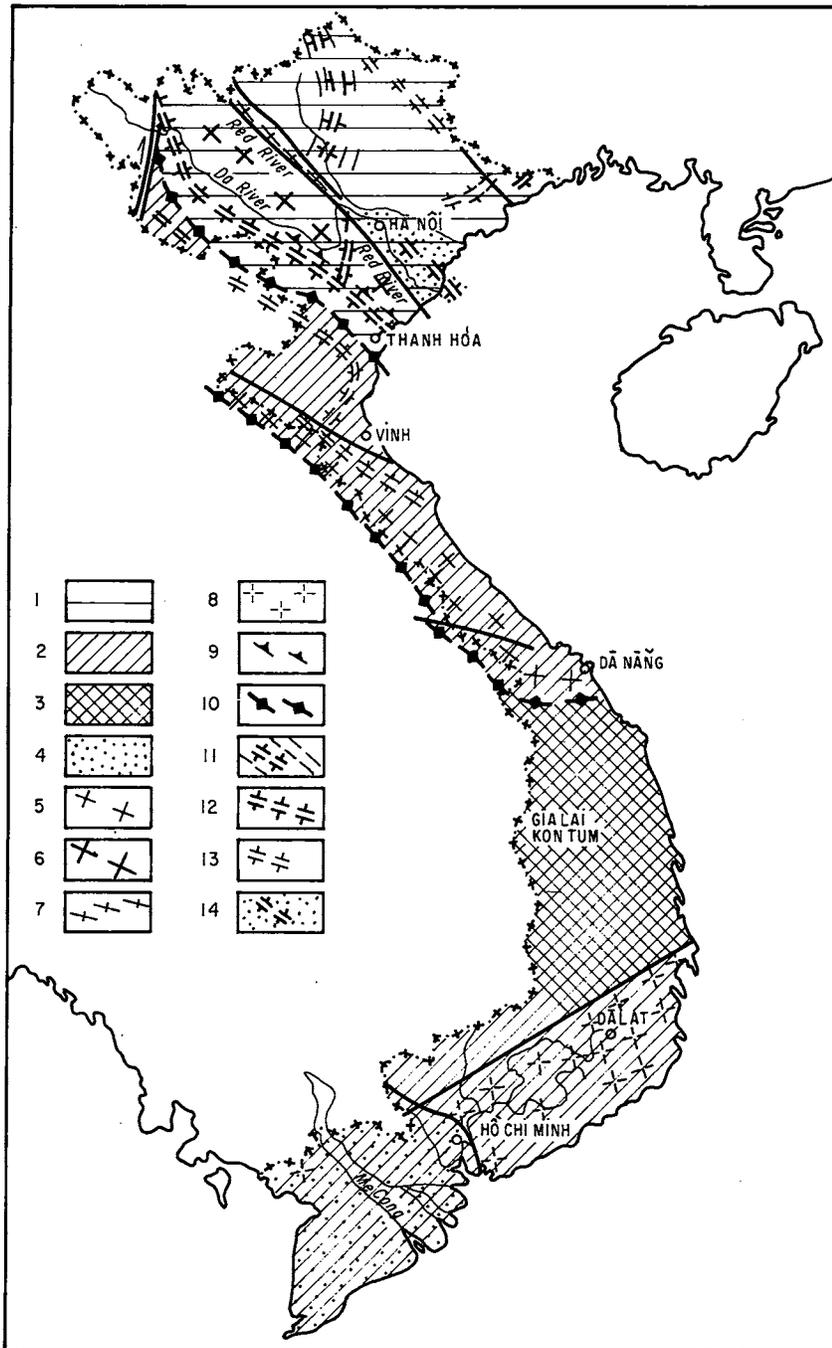


Fig. 1. MINERAL MAP OF VIETNAM

- (a) **Tectonic Background:** 1-South China Plate, 2-Indochina Plate, 3-Kontum Massif, 4-Red River and Mekong River Cenozoic Depressions, 5-Truongson Mid-Palaeozoic Magmatic Arc, 6-Hoanglienson Meso-Cenozoic Magmatic Arc, 7-Convoi Back-Arc Thrust, 8-Back-Arc Magmatic Belt of Dalat, 9-Da River inactive Meso-Cenozoic Subduction, 10-Truongson and Ma River Palaeozoic Collision Zones, 11-Vietbac Mid-Palaeozoic Back-Arc Rift, 12-Da River Late Palaeozoic-Early Mesozoic deep-seated Continental Rift, 13-Triassic Continental Rift, 13-Triassic Continental Rifts, 14-Red Cenozoic Rift.

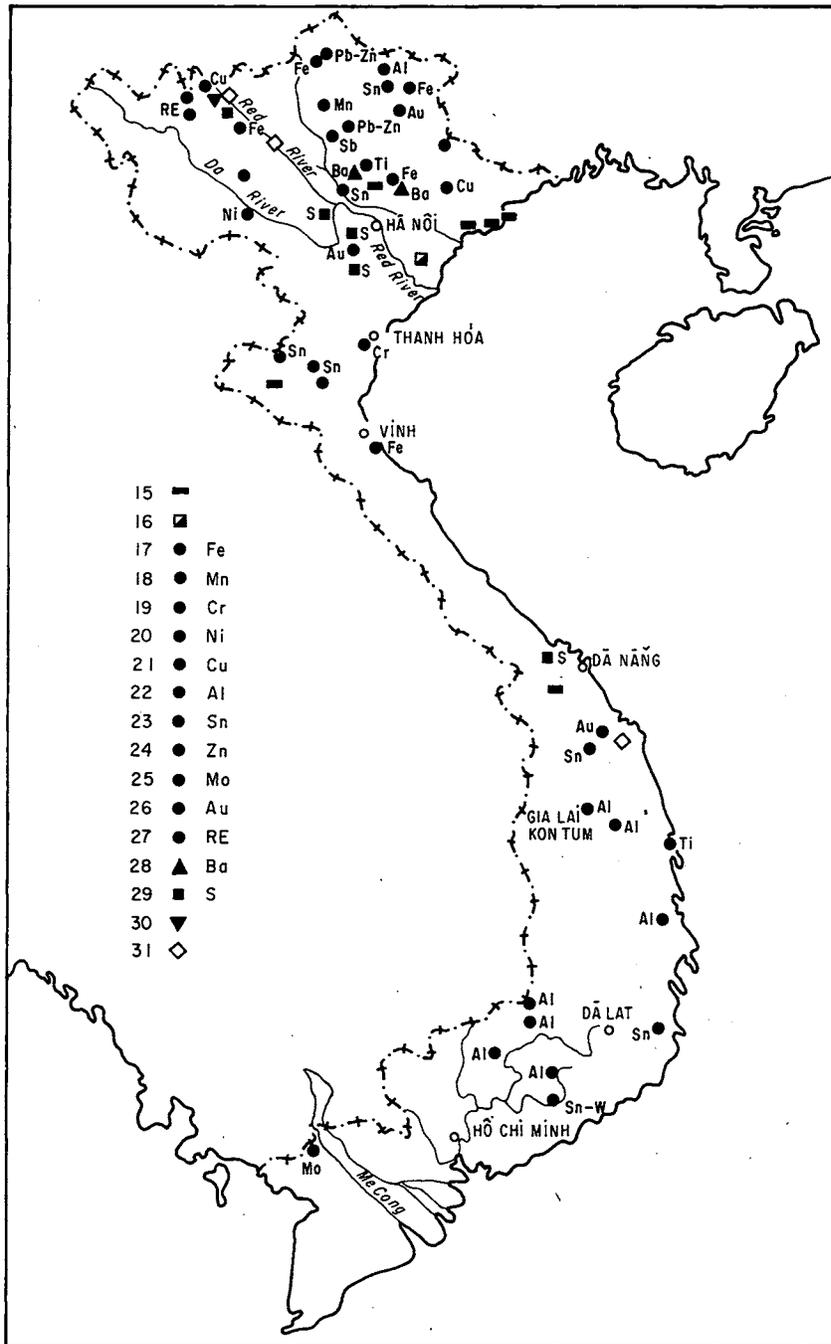


Fig. 1. MINERAL MAP OF VIETNAM

(b) **Mineral Resources:** 15-Coal, 16-Lignite, 17-Iron Ore, 18-Manganese Ore, 19-Chromite, 20-Nickel, 21-Cu, 22-Aluminium, 23-Tin, 24-Zinc (Lead), 25-Molybdenium, 26-Gold, 27-Rare Earths, 28-Barite, 29-Pyrite, 30-Apatite, 31-Graphite.

Copper

Copper and nickel-copper are mainly located in the northwest of the country where there are a lot of mafic and ultramafic rocks. Nickel and copper deposits related to Palaeozoic and Mesozoic ultramafic and mafic rocks are located in the Da river zone and, other copper deposits are hosted in Precambrian meta-sediments close to the Red river.

Chromite

Large reserves of chromite have been prospected and mined in Quaternary alluvial sediments located along the foot of ultramafic rock massifs of Palaeozoic age in Thanhhoa Province.

Lead and Zinc

The main deposits of lead and zinc are located in the north of the country within the belt of terrigenous and carbonate sediments interbedded by acidic and alkaline volcanic rocks of Silurian-Devonian age. Lead and zinc ores of stratiform and vein types are likely to be deposited during the continental rifting conditions of the Middle Palaeozoic. Besides, lead and zinc mineralization associated with iron and manganese formations are also found interbedded with the Silurian and Devonian formations.

GROUNDWATER, MINERAL WATER INVESTIGATION

The most striking achievement in this field for the recent years is the completion of a hydrogeological map at a scale of 1/500,000 covering the entire territory of Vietnam. The map shows prospects and potential of groundwater resources in Vietnam, related to different water bearing formations.

Red river plain, Mekong River delta and Southwestern plateaux are under investigations with the purpose of compiling hydrogeological maps at a scale of 1/200,000 and for water supply. In recent years numerous urban and rural areas have been investigated and supplied with groundwater.

New methods are being applied to groundwater researches e.g. isotopic analysis has been used to identify ages of groundwater horizons and recharging sources of Red and Mekong River deltas. Hundreds of mineral and thermal springs are being studied for health and energy purposes. Some geothermal resources are used for drying agricultural products. The hot springs in Central Vietnam are being studied for feasibility of electric power generation.

GEOPHYSICAL INVESTIGATIONS

In addition to the above, the completion of the gravimetric map at a scale of 1/500,000 for the south is a remarkable advancement. Such a map has already been completed for the north. In the meantime some transects in the north have been conducted by seismic and gravimetric methods to identify the main geological structures.

Airborne geophysical work has been carried out with more sophisticated instruments and equipment which have resulted in improving the geophysical investigations. Some onland geophysical methods have been effectively applied to prospecting work on sulphide ore bodies.

As regards offshore investigation, geophysical work is being implemented to identify geological structures, especially those that are favourable for hydrocarbon accumulation.

GEOLOGICAL RESEARCH AND APPLICATION OF ADVANCED TECHNOLOGY

Recently geological research has concentrated on programmes to solve crucial problems on energy and mineral resources such as energy, mineral, regional geology, base metals, etc.

Metallogenic studies and mineral investigations are being intensified. To carry out the challenging tasks, the Geological Institutes and Regional Divisions need better equipped laboratories. A newly established isotopic age dating laboratory with mass spectrometer will soon be available for analytical studies. A scanning electron microscope and X-ray fluorescence laboratory is effectively helping geoscientists in their research work. Atomic absorption method is replacing old, wet chemical analysis in geological research.

Remote sensing techniques are also effectively applied to geology and hydrogeology investigations. Airborne and satellite photo analysis has been used in the compilation of geological maps and mineral resources investigation. A geological structure map for the whole country is being compiled with the purpose of identifying the areas with prospects in endogenic ores. Remote sensing techniques and photo-image analysis are being used to determine saline zones along the coastal areas. A Geoinformation Center has been set up equipped with an electronic computer to process and store geological, geophysical, hydrogeological, airborne geophysical data, etc ...

CONCLUSIONS

Vietnam has gone through a difficult period during the wars. However, the above mentioned advances in geoscience knowledge achieved during the past years are remarkable. With the assistance of the Vietnam Government a large number of geoscientists numbering nearly 3000 who have graduated from either overseas or local institutions or universities are conducting geological work both in the field and in the laboratories.

The equipment and advanced technology obtained by various aid programmes have made substantial contributions to our recent achievements. Confronting us are lots of difficulties that we have to overcome to modernize our geological investigations and to publish geological maps, research results etc. In obtaining technological transfer and modern equipment the cooperation in geological investigations between geoscientists in GEOSEA countries are very helpful.

ACKNOWLEDGEMENTS

Sincere thanks are heartily extended to the leaders of the General Department of Geology S.R. Vietnam and other colleagues for their help in making this report.

Manuscript received 11th September 1984.