CONTENTS

Part I
Proclaiming Geoheritage Resources

1. Proclaiming Geoheritage Resources in Malaysia
   Ibrahim Komoo

2. Towards Proclaiming Fossil as National Heritage
   Basir Jasmin

3. Limestone Hills in Malaysia: Geoheritage Potentials and Threats
   Che Aziz Ali

Part II
Characterisation of Geoheritage

4. Magnetic Cassiterite from Peninsular Malaysia
   Wan Fuad Wan Hassan

5. Geology and Landscape Diversity of the Banggi Archipelago, Kudat, Sabah
   Felix Tongkul, Harry Benedick & Chang Fui Khiong

6. Igneus Complex of the Mersing Archipelago - Geological Heritage of Johor
   Mohd. Fauzi Rajimin @ Jeman

7. Intensity of the Earth Magnetic Field Surveys and its Relation to the surface
   Geology of Tuba Island and the Machinchang Geoforest Park, Langkawi
   Abdul Rahim Samsudin, Nurul Baizura Mohd Yunus &
   Kamal Roslan Mohamed

8. Characterising Geosites of Heritage Value in the Vicinity of the Machinchang
   Cambrian Geoforest Park, Langkawi
   Tanot Unjah & Ibrahim Komoo

9. Potential of Gua Cha as a Geoheritage Site in Kelantan
   Mohamad Umar Sarimal

10. Geological Heritage of Mulu National Park
    Dana Badang

11. Petrified Wood of Sarawak: A Suggestion
    Askury Abd. Kadir
12. Some Outstanding Geological Heritage Features of Kinabalu Park, Sabah
Tungah Surat

Part III
Development of Geoheritage

13. Gunung Senyum Recreational Forest as a Geoforest Park
Kamal Roslan Mohamed & Che Aziz Ali

14. Potential of Sustainable Development of Geoheritage Resources of Lembah Kinta
Ishlahuda Hani Sahak, Mohd Shafeea Leman, Ros Fatihah Muhammad & Mohd Irwan Ariff

15. Historical Development of Geoheritage Conservation Initiatives in Malaysia
Mohd Shafeea Leman, Ibrahim Komoo & Tanot Unjah
1

PROCLAIMING GEOHERITAGE RESOURCES IN MALAYSIA

Ibrahim Komoo

Institut Alam Sekitar dan Pembangunan (LESTARI)
Universiti Kebangsaan Malaysia

SUMMARY

Geoscientists' community have accustomed to introducing geological resources to the public as earth materials of economic value - ore or raw materials to produce metal and non-metallic material for manufacturing and construction industries. Geoheritage as a geological resource is a novel idea that introduces earth material as an integral component that consists of scientific, historical, recreational and aesthetic values. These values are important and closely linked to the culture of societies and human civilization. Geoheritage promotes utilisation without destruction, it is a non-renewable earth resource that should be protected, conserved and used in a sustainable manner for the sake of future generation and to uphold environmental integrity. Thus, research and development of geoheritage resources should be carried out innovatively to serve as the basis of science, planning and governance to ensure effective conservation and sustainable utilisation. The concepts of geodiversity, geoheritage, geosite, geoconservation, geoforest park and geopark were introduced in the field of Geological Conservation. The exploration of new knowledge as such is indeed critical to enhance geoheritage intrinsic values - uniqueness, rarity, aesthetic, historic and cultural - as basic foundation to develop geoheritage. As an emerging field of knowledge, main challenge lies on greater effort needed in developing research methodologies, such as characterization, assessment and evaluation. This effort should also be carried out simultaneously in building capacity and human capital, increasing awareness and encouraging public involvement together with public education and conservation governance. However, fundamental challenge remains mostly within geoscientists' acceptance to have a paradigm shift, their willingness to embrace Geological Conservation as one of corpus if knowledge and commitment in developing it as one of geology sub-fields. Ultimately, various strategies are needed in order to strengthen geoheritage resources for the benefit of all humankind.
2

TOWARDS PROCLAIMING FOSSIL AS NATIONAL HERITAGE

Basir Jasin

Pusat Pengajian Sains Sekitaran dan Sumber Alam
Universiti Kebangsaan Malaysia

SUMMARY

Fossils are natural heritage resources which are very important for age determination, paleogeography, paleoclimate and the history of the past living organism through time. Fossils should be conserved and preserved. Although the stratigraphic distribution of Malaysian fossils is not complete, they show an interesting diversity. From the total number of fossil species discovered, 184 species are endemic which were first discovered in Malaysia. These species should have the holotypes (type specimens) kept in Malaysia. However, to date depository of these specimens are not known. Fossils are non-renewable resources which are facing natural destruction such as weathering and erosion and destruction by anthropogenic activities such as land developments, quarrying, infrastructure developments and minings. In order to establish fossils as a National heritage, efforts must be carried out to conserve fossils ex-situ and in-situ, to collect and preserve the fossils, systematically naming the fossils, to propose fossil conservation act, to develop a proper natural history museum and to have a central committee for fossil conservation which consists of representatives from local universities, Mineral and Geoscience Department, Museum Department and Ministry of Culture and Heritage. Natural history museum is very important as a depository and ex-situ systematic conservation, and exhibition of fossils which can create awareness and to educate the public regarding the existence of fossils and their importance as national heritage. Ex-situ conservation in the museum provides information that could attract tourists to visit the fossil geosites. This is the catalyst for fossils tourism.
LIMESTONE HILLS IN MALAYSIA: GEOHERITAGE POTENTIALS AND THREATS

Che Aziz Ali

Kumpulan Warisan Geologi Malaysia LESTARI
Universiti Kebangsaan Malaysia

SUMMARY

Limestone is made up of calcium carbonate material which can be easily weathered and eroded to form unique landscapes that hosts its own sensitive and fragile biodiversity. Malaysia owns many beautiful limestone hill and karst some of which are already becoming tourist destinations while others are undergoing threats due to uncontrolled quarrying and other human activities. Its different physical and chemical properties from other rocks make the limestone more important and having high scientific, cultural, recreational and economic values. Apart from scientific value, other values especially its high economic value has attracted more threats. If the conservation effort is not increased according to the rate of development and the demand for the limestone-based material, these high heritage value limestone hills and landscapes will be lost forever.
SUMMARY

Cassiterite, $\text{SnO}_2$, the main ore mineral of tin, is supposedly non-magnetic. However studies on this mineral taken from several places in Peninsular Malaysia found that some cassiterite grains are actually magnetic. Magnetic cassiterites in this study are divided into three types viz. paramagnetic, ferromagnetic and inclusion-bearing cassiterites. Paramagnetic cassiterite is found in the pegmatitic tin deposits of Semiling (Kedah) and Bukit Mor (Johor). In comparison ferromagnetic cassiterite is found in the hydrothermal tin deposit samples from Pelepah Kanan (Johor), Gambang and Bukit Payung (Pahang) and Paka (Terengganu). Inclusion-bearing cassiterite has been reported from Sungai Lembing (Pahang). This work studies cassiterite using polished sections, electron microprobe and heat treatment to explain the source of the magnetism. From the heat treatment, paramagnetic cassiterite is observed to remain magnetic even after beating whereas ferromagnetic cassiterite changed colour and lost its magnetism. Polished section study revealed that paramagnetic cassiterite contains many mineral phases in the form of exsolution bodies and inclusion, composed of columbite-tantalite, ilmenite and magnetite. Ferromagnetic cassiterite generally does not contain inclusion. Microanalysis of the cassiterite itself show the presence of iron in the crystal lattice attaining up to a maximum of 1.00%. In conclusion it is suggested that magnetism in paramagnetic cassiterite is caused by exsolution and inclusion of columbite-tantalite, Nb-Ta rutile, ilmenite and magnetite. Ferromagnetic cassiterite is caused by high Fe content in the $\text{SnO}_2$ lattices and in the other cassiterites, magnetism is due to inclusion and intimate growth with iron-containing minerals.
Banggi Island cluster comprising 51 islands possess high geological and landscape diversity. A large part of the early geological history of Sabah which started with the formation of a Mesozoic oceanic crust is recorded in the pillow lavas and cherts here. The imbrication history of the ancient oceanic crust which involved serpentinite, basalt and chert is clearly recorded on Maliangin Besar Island. Geological record related to the development of coral reefs in this region during the Miocene-Pliocene is well recorded in the limestone in the southern part of Banggi Island. Weathering and erosion processes have created mountains, hills and valleys. Coastal processes have created rocky and sandy beaches. Quaternary tectonic uplift and subsidence have created cliffs and swampy bays, respectively.
SUMMARY

Islands off Mersing, Johore have various geological treasures and resources which are unique and hardly found elsewhere, including rock type diversity, morphology, landscape and coast. The archipelago which comprises 13 islands is part of Johore Marine Park. Main islands such as Pulau Besar, Pulau Tinggi, Pulau Sibu, Pulau Aur and Pulau Pemanggil have already become main attraction for tourist and scuba diver because of their beautiful coast and coral reef. Field observation shows that each island has its distinctive geological features. Pulau Besar consists of granite rock, metasediment, and dolerite dyke. The granite has a very high SiO₂ content which rarely found in large total volume. Pulau Sibu and Pulau Tinggi are also dominated by volcanic rock of lava and pyroclastic type. Layered volcanic can be found on both Island especially on Pulau Sibu forming features similar to sedimentary rock. Pulau Tinggi forms the highest peak in Mersing. Pulau Aur and Pulau Pemanggil are also formed by igneous plutonic rock which are located at the easternmost in the Eastern Belt of Peninsular Malaysia. Both islands constitute intermediate to mafic plutonic rocks such as syenite, diorite, trachyte and gabbro. Many attractive rocky coasts can also be found in the area such as rock dome morphology in Teluk Buau, Pulau Pemanggil and a smooth cliff of about one kilometer long in Tanjung Neratan, Pulau Dayang. All of them form beautiful landscapes, waiting for more studies and conservation effort to be done.
INTENSITY OF THE EARTH MAGNETIC FIELD SURVEYS AND ITS RELATION TO THE SURFACE GEOLOGY OF TUBA ISLAND AND THE MACHINCHANG GEOFOREST PARK, LANGKAWI

Abdul Rahim Samsudin
Nurul Baizura Mohd Yunus
Kamal Roslan Mohamed

Pusat Pengajian Sains Sekitaran dan Sumber Alam
Universiti Kebangsaan Malaysia

SUMMARY

Ground magnetic surveys were conducted to investigate the influence of different rock types on the intensity of the earth magnetic field in Tuba Island and Machinchang Geoforest Park, Langkawi. The magnetic measurements were conducted using proton precession magnetometer along several traverses in the granite and sedimentary rocks areas as well as in the alluvial area on the Tuba Island. Several magnetic profile were established in area of the Machinchang Geoforest Park which comprises mainly sandstone of the Machinchang Formation. Some profiles were run perpendicular to the lithological boundary. The results of the study revealed that the intensity of the earth magnetic field in the granite area on the Tuba Island is relatively higher (ranging from 41450 to 41500 gamma) than the magnetic field intensity in the alluvial area (41300 to 41480 gamma). Whereas in the area covered by the sedimentary rocks of the Setul Formation, the magnetic field fluctuated in intensity along the profiles with the recorded intensity values (from 41460 to 41550 gamma) slightly higher than those measured in the granite areas. The fluctuation of the magnetic field readings with high intensity values are interpreted to be caused by the presence of high and irregular content of the magnetic minerals in the rock of Setul Formation. Geochemical analysis using Atomic Absorption Spectrometry (AAS) method indicates high content of iron oxide in this sediment which supported the above interpretation. A similar pattern of irregular and high magnetic field readings were also observed in profiles surveyed in the Machinchang Geoforest Park, where the intensity values range from 41200 to 41700 gammas. In an area near Kg. Kok Bam, the intensity of the earth magnetic field showed significantly high values which ranges from 42100 to 42500 gammas.
CHARACTERISING GEOSITES OF HERITAGE VALUE IN THE VICINITY OF THE MACHINCHANG CAMBRIAN GEOFOREST PARK, LANGKAWI

Tanot Unjah
Ibrahim Komoo

Institut Alam Sekitar dan Pembangunan (LESTARI)
Universiti Kebangsaan Malaysia

SUMMARY

Thirteen geosites have been identified and highlighted as geotourism resource within Machinchang Cambrian Geoforest Park. Out of this list eight of the geosites recognised are having high scientific value representing rock, primary structures and landscape diversities while the other five are representing landscape diversity. Geosites around Machinchang Cambrian Geoforest Park are scientifically important for research and education as the evidence of oldest rock in the country of 550 million years old. Other diversity features resulted from the contact between sedimentary and igneous rocks and various features resulted from waves erosion are exposed in the area closed to the sea. From recreational aspect, geosites in this area which are represented by Temurun Waterfall and Telaga Tujuh waterfall are of the highest value whilst the Datai beach is the best sandy beaches in the island. In geopark context all these geosites should be combined with biological, historical and cultural resources for establishing tourism trail as aspired in geopark development programme.
POTENTIAL OF GU Cha AS A GEOHERITAGE SITE IN KELANTAN

Muhammad Umar Sarimal
Jabatan Mineral dan Geosains Malaysia, Kelantan

SUMMARY

Gua Cha is located 48 km to the northwest of Gua Musang Town. It is situated on the western bank of Sungai Nenggiri approximately 16 km downstream of Kampung Kuala Betis. Gua Cha, which is cone-shaped, is around 150 m in length and about 20 171 high. Gua Cha has become a popular site due to archeological artifact found which proved the presence of prehistoric human from the 'Hoabinhian' and Neolithic era (approximately 10,000 and 4,000 years ago). Gua Cha belongs to the Gua Musang formation which was deposited during the Middle Perm until Middle Triassic in shallow marine environment. Gua Cha was formed in the limestone hill through the process of dissolution. Rocks unit found here are grey in color, hard and fine-grained. Stalactites appear like benches of flowers, an umbrella and human fingers are of high aesthetic value. Besides that, cemented limestone fragments also occur at several level in the cave roof.
GEOLOGICAL HERITAGE OF MULU NATIONAL PARK

Dana Badang

Jabatan Mineral dan Geosains Malaysia

SUMMARY

Mulu National Park is the largest national park in Malaysia, located in northern Sarawak. The park consists of amazing natural uniqueness of the geological, biological and cultural aspects. The geology is made up by Tertiary sediment such as alluvium, sandstone and limestone formation. The geodiversity is the fundamental for the existing of biodiversity in Mulu. The park hosts natural habitat of tropical rainforest forming the beautiful landscape with high heritage vallue, particularly within the Melinau Limestone. The combination of geology, landscape and biology had transform Mulu National Park to become the most established nature tourism (ecotourism) destination. The importance of geodiversity and geological heritage landscape have been particularly considered to enhance ecotourism promotion in Mulu National Park. The ongoing geological mapping within the area will be the additional documentation to the geological heritage. This particular information are very much important for geological heritage in order to establish the ecotourism activities based on geological aspect or geotourism in the Mulu National Park.
PETRIFIED WOOD OF SARAWAK: A SUGGESTION

Askury Abd. Kadir

Geoscience & Petroleum Engineering Department
Universiti Teknologi PETRONAS

SUMMARY

The Sarawak petrified woods occurred within the Tertiary Kayan Sandstone in the vicinity of Bungo range which are being threaten and seem to be permanently destroyed by illegal exploitation activities. The uncontrolled illegal exploitation has caused the geological artifacts being widely traded without paying any tax to the government. The petrified wood, including palm and conifer trees had undergone petrification for million of years, by silicate minerals, such as opal and chalcedony. The transformation processes are unique in term of petrification, and can be translated into very high aesthetic and scientific values among geoscience and local communities. The wood structures including their cells are retained and can be observed either macroscopically or microscopically. The varieties of color and degree of preservation of the Sarawak petrified woods are attractive and comparable with other petrified wood reported around the world. The relevant government bodies are greatly required for promoting and publicizing our hidden treasures for the benefit of our future generation. The SWOT analysis for petrified wood revealed a lot of opportunities for geoscience community to safeguard these treasures from any destruction of human activities. The area where the petrified woods are found can be transformed into research sites that can attract local and international researchers. The strength obtained from this analysis shows that the existing infrastructure around the area can be a momentum for further development, viz: Borneo Height (highlands & golf tourism), Kg. Annah & Rais (cultural village for Bidayuh ethnic group), Semenggok (Orang Utan Rehabilitation Centre), hot spring and Kg Sadir (Bidayuh village).
SUMMARY

Kinabalu Park, in the State of Sabah, Malaysia, is dominated by Mount Kinabalu (4,095 m), the highest mountain between the Himalayas and New Guinea. It has a very wide range of habitats, from rich tropical lowland, hill rainforest, to tropical mountain forest, to sub-alpine forest and scrub on the higher elevations. The park comprises three main mountains, from south to north, Kinabalu (4,095 m), Tambuyukon (2,579 m) and Templer (1,133 m). Major topographical features include peaks and plateau, gullies, rivers, streams, waterfalls, hot springs, caves and granitic body, characterised the slopes of the summit. Unique displays of the effects of past glacial activities in the shape of "nunataks" jagged peaks (such as Low’s Peak and South Peak), striations, grooves and polished surfaces, the creation of cirques, U-shaped valleys, gullies, roche moutonnes and deposit of glacial moraines are worth considering for conservation. The granite intrusive, ultrabasic, sedimentary and metamorphic rocks which are present will also compliment the conservation efforts in promoting the Kinabalu Park as "Geological Heritage" site or "Geopark".
SUMMARY

Geoforest park is an area within a permanent reserved forest that have unique geological formations. This concept is an innovative approach towards conservation of both biological and geological resources. It integrates the natural forest vegetation and unique geological heritage resources that will provide an excellent opportunities for researchers, tourist and general public to appreciate the beauty of the forest vegetation and geological formations. Gunung Senyum Recreation Forest consists of Permian to Triassic limestone and magnificent landscape of nearly vertical to sub-rounded karstic hills. Within the recreation forest, there are numerous caves and speleotherm that provide great place for people to appreciate and conserve it's natural heritage. It is proposed that the Gunung Senyum Recreational Forest to become a geoforest park.
POTENTIAL OF SUSTAINABLE DEVELOPMENT OF GEOHERITAGE RESOURCES OF LEMBAH KINTA

Ilshlahuda Hani Sahak\textsuperscript{1}
Mohd Shafeea Leman\textsuperscript{1}
Ros Fatihah Muhammad\textsuperscript{2}
Mohd Irwan Ariff\textsuperscript{3}

\textsuperscript{1}Institut Alam Sekitar dan Pembangunan (LEST ARI), UKM
\textsuperscript{2}Jabatan Geologi, Universiti Malaya
\textsuperscript{3}Jabatan Mineral dan Geosains Perak

SUMMARY

Kinta Valley in the State of Perak is well-known not only for its mining history but also because it is rich in geological history and natural landscape. Among interesting geological heritage features in this valley include a number of caves, waterfalls and rapids on the foot of the Titiwangsa Range, landscape of mountains and limestone hills, hot springs, archeological sites and remains of tin mining activities. The special geological setting of Kinta Valley has made it a well known tin producer not so long ago, which contributed to the economic development of the country. Due to the special geological environment of Kinta Valley most of the caves have their own unique history of settlement and became shelter for primitive communities, worshiping temples for Chinese and Indian, and tin mines. These geological, archeological and biological resources which are unique, endemic and endangered, together with the various culture and tradition of local people in Kinta Valley can be developed into major tourist attractions. Some of these heritage resources are facing serious degradation problems because of the unsustainable development of industries related to mineral industry. Holistic nature conservation and sustainable development program through geotourism and geopark would enhance the image of Kinta Valley in the eyes of the public, both locally and internationally.
HISTORICAL DEVELOPMENT OF GEOHERITAGE CONSERVATION INITIATIVES IN MALAYSIA

Mohd Shafeea Leman
Ibrahim Komoo
Tanot Unjah

Institute for Environment and Development (LESTARI)
University Kebangsaan Malaysia

SUMMARY

Malaysia has established the Langkawi Archipelago as its first national geopark in May 2006, and barely a year later, the Langkawi Geopark has been inaugurated as the 52nd member of the Global Network National Geoparks by the UNESCO Division on Ecological and Earth Sciences. This has been realized as a result of concerted group efforts to promote Malaysia’s geoheritage resources for conservation. Malaysian Geological Heritage Group (MGHG) formed in 1996 was responsible in making geoheritage conservation one of the current national agenda. MGHG started its effort by linking geology with tourism in order to create interest among stakeholders. This was followed by more campaigns to generate awareness to broader spectrum of stakeholders from policy makers to the general public on the importance of conserving national geoheritage. Comprehensive research framework and development plan were built to assist researchers in building national geoheritage database and proposals for sustainable geoheritage development. The group is currently assisting the development of National Geopark Unit and providing technical expertise to inspired local authorities in establishing their national and global geoparks. Malaysian Geological Heritage Group is also currently hosting the Secretariat for the Asia Pacific Geoheritage and Geoparks Network to provide a platform for networking among geoparks and to assist inspired national and global geoparks in the region.