1 | Satu garis masa, pelbagai rekod

One timeline, many records



Ilustrasi konsep / Conceptual illustration — lapisan batuan / rock layers

Dari Semenanjung Malaysia ke Melaka

From Peninsular Malaysia to Melaka

Panel ini menyandingkan sejarah geologi serantau dengan rekod tempatan Melaka, kemudian beralih kepada sejarah manusia. Perbandingan geologi dalam nota ini tertumpu pada Semenanjung Malaysia. Pada masa yang sama, satu kawasan boleh menjadi laut cetek, kawasan lain laut dalam, dan kawasan lain mengalami rejahan magma.

The panel aligns regional geological history with Melaka's local record before turning to human history. Geological comparisons in these notes focus on Peninsular Malaysia. At any one time, one area may be a shallow sea, another a deep sea, while magma intrudes elsewhere.

Bagaimana peristiwa dipadankan?

How are events correlated?

Ahli geologi menggabungkan susunan lapisan, fosil, hubungan batuan yang saling memotong dan pentarikhan mineral. Nama zaman seperti Trias ialah unit masa; nama formasi seperti Gemas ialah unit batuan. Dua formasi boleh terbentuk serentak walaupun rupanya berbeza. Usia sedimen asal, metamorfisme dan rejahan juga boleh mewakili peristiwa berlainan.

Geologists combine layer sequences, fossils, cross-cutting relationships and mineral dating. A period such as the Triassic is a time unit; a formation such as Gemas is a rock unit. Two formations may develop at the same time despite looking different. Original deposition, metamorphism and intrusion can also record separate events.

2 | Laut purba sebelum Melaka hari ini

Ancient seas before present-day Melaka



Ilustrasi konsep / Conceptual illustration — pemendapan sedimen laut / marine sediment deposition

Semenanjung | Kambria hingga Ordovisi

Peninsula | Cambrian to Ordovician

Formasi Machinchang di Langkawi menyimpan rekod pasir, lumpur dan kelikir dalam sekitaran delta, muara serta pesisir purba. Pemendapan karbonat kemudian berkembang di barat laut Semenanjung, termasuk unit batu kapur dalam Kumpulan Setul. Rekod ini menunjukkan perubahan sekitaran laut sepanjang Paleozoik awal.

The Machinchang Formation in Langkawi preserves sand, mud and gravel deposited in ancient deltaic, estuarine and coastal settings. Carbonate deposition later developed in the northwestern Peninsula, including limestone units of the Setul Group. These records show changing marine environments during the Early Palaeozoic.

Melaka | sedimen yang menjadi Syis Jelebu

Melaka | sediment that became Jelebu Schist

Dalam rangka sejarah Melaka, bahan asal Syis Jelebu dikaitkan dengan pemendapan lumpur dan pasir Paleozoik, khususnya Ordovisi-Devon. Sedimen ini kemudiannya mengalami metamorfisme. Batuan Langkawi dan Melaka sama-sama membantu membaca laut purba, tetapi mewakili bahan, sekitaran dan sejarah perubahan yang berlainan.

In Melaka's geological framework, the precursor of Jelebu Schist is associated with Palaeozoic mud and sand deposition, particularly the Ordovician-Devonian. These sediments were later metamorphosed. Both Langkawi and Melaka help reveal ancient seas, but record different materials, environments and subsequent transformations.

3 | Dua blok bergerak menuju pertemuan

Two blocks move towards convergence



Ilustrasi konsep / Conceptual illustration — pertemuan kerak benua / continental convergence

Semenanjung | sebelum penyatuan Trias

Peninsula | before Triassic assembly

Blok Sibumasu dan Blok Malaya Timur mempunyai sejarah awal yang berbeza sebelum bercantum. Kedua-duanya berkait dengan pecahan Gondwana yang berhijrah pada masa berlainan. Menjelang Perm, Sibumasu bergerak ke utara, manakala Lautan Paleo-Tethys terletak di antara blok-blok yang semakin menghampiri.

Sibumasu and East Malaya had different early histories before joining. Both are linked to fragments of Gondwana that migrated at different times. By the Permian, Sibumasu was moving northwards, with the Paleo-Tethys Ocean between the converging blocks.

Melaka | mengapa rekod batuannya berbeza?

Melaka | why do its rock records differ?

Kerangka ini membantu menjelaskan hubungan Syis Jelebu di bahagian Sibumasu dengan sedimen Gemas pada bahagian Malaya Timur. Kawasan yang kini berjiran tidak semestinya berjiran ketika bahan batuannya terendap. Peta Melaka hari ini ialah hasil penyatuan, canggaan dan hakisan yang berlaku jauh kemudian.

This framework helps explain the relationship between Jelebu Schist on the Sibumasu side and Gemas sediments on the East Malaya side. Areas that are neighbours today were not necessarily neighbours when their rock materials were deposited. Modern Melaka reflects much later assembly, deformation and erosion.

4 | Sedimen laut bersama bahan volkanik

Marine sediment and volcanic material



Ilustrasi konsep / Conceptual illustration — bahan volkanik masuk ke laut / volcanic material entering the sea

Semenanjung | Perm-Trias

Peninsula | Permian-Triassic

Pada bahagian Malaya Timur, aktiviti volkanik menyumbang abu dan serpihan kepada lembangan laut. Jujukan Semantan di Jalur Tengah mengandungi batuan sedimen serta bahan volkanik. Kehadiran lapisan pasir, lumpur dan tuf merekodkan perubahan bekalan sedimen serta kegiatan gunung berapi di kawasan sumber.

On the East Malaya side, volcanic activity supplied ash and fragments to marine basins. The Semantan succession in the Central Belt contains sedimentary rocks and volcanic material. Sand, mud and tuff layers record changing sediment supply and volcanic activity in source areas.

Melaka | Formasi Gemas dalam konteks serantau

Melaka | the Gemas Formation in its regional context

Formasi Gemas merekodkan pemendapan pasir, lumpur dan bahan volkanik di laut. Buku Geology of Peninsular Malaysia menghubungkan Gemas dengan kesinambungan sisi jujukan Semantan ke selatan. Maka, batuan di Melaka boleh difahami sebagai sebahagian sejarah lembangan yang lebih luas, bukan satu kejadian yang terasing.

The Gemas Formation records marine deposition of sand, mud and volcanic material. Geology of Peninsular Malaysia relates Gemas to the southward lateral continuation of the Semantan succession. Melaka's rocks can therefore be understood within a wider basin history rather than as an isolated occurrence.

5 | Trias: penyatuan dan perubahan batuan

Triassic: assembly and rock transformation



Ilustrasi konsep / Conceptual illustration — rejahan magma dalam kerak / magma intrusion within the crust

Semenanjung | pembinaan kerak benua

Peninsula | building continental crust

Penutupan Paleo-Tethys diikuti penyatuan Sibumasu dan Malaya Timur pada zaman Trias. Zon Sutura Bentong-Raub menandakan sejarah pertemuan ini. Mampatan, penebalan kerak, metamorfisme dan rejahan granit menjadi sebahagian episod pembentukan pergunungan yang dikenali sebagai Orogeni Indosinia.

Closure of the Paleo-Tethys was followed by Triassic assembly of Sibumasu and East Malaya. The Bentong-Raub Suture records this convergence. Compression, crustal thickening, metamorphism and granite intrusion formed part of the mountain-building episode known as the Indosinian Orogeny.

Melaka | syis, granit dan bukti yang terpelihara

Melaka | schist, granite and preserved evidence

Syis memperlihatkan penyusunan semula mineral, sementara granit terbentuk daripada magma yang menghablur di bawah permukaan. Singkapan metamorf Tanjung Tuan dan granit pesisir Melaka membantu menggambarkan dua proses ini. Pengangkatan dan hakisan kemudian menyingkap batuan; perlanggaran ialah episod panjang, bukan kejadian serentak di semua tempat.

Schist shows mineral reorganisation, while granite forms from magma crystallising below the surface. Tanjung Tuan's metamorphic outcrops and Melaka's coastal granites illustrate these processes. Later uplift and erosion exposed the rocks; collision was a prolonged episode, not an instantaneous event everywhere.

6 | Jura-Kapur: daratan terus berubah

Jurassic-Cretaceous: a changing land



Ilustrasi konsep / Conceptual illustration — aplit memotong granit / aplite cutting granite

Semenanjung | lembangan daratan dan magma lebih muda

Peninsula | continental basins and younger magmatism

Selepas penyatuan Trias, sedimen terkumpul dalam lembangan daratan, termasuk jujukan yang dikaitkan dengan Kumpulan Tembeling. Pasir, kelikir dan lumpur merekodkan hakisan kawasan tinggi serta pemendapan dalam lembangan. Rejahan granit juga berlaku semula di beberapa tempat pada zaman Kapur.

After Triassic assembly, sediments accumulated in continental basins, including successions associated with the Tembeling Group. Sand, gravel and mud record erosion of high ground and deposition within basins. Granite intrusion also recurred in some areas during the Cretaceous.

Melaka | granit tidak semuanya sebaya

Melaka | not all granite is the same age

Granit Batang Melaka dikelaskan dalam buku rujukan sebagai pluton Kapur, berbeza daripada episod utama Granit Banjaran Utama. Korok aplit pula merekodkan magma memasuki rekahan batuan yang telah wujud. Aplit yang memotong granit lebih muda daripada perumahnya, tetapi warna cerah sahaja tidak menentukan usia mutlaknya.

The reference book classifies Batang Melaka Granite as a Cretaceous pluton, distinct from the main Main Range Granite episode. Aplite dykes record magma entering fractures in existing rock. Aplite cutting granite is younger than its host, but pale colour alone does not determine its numerical age.

7 | Kenozoik: daripada batuan kepada tanah

Cenozoic: from rock to soil



Ilustrasi konsep / Conceptual illustration — profil luluhawa / a weathering profile

Semenanjung | luluhawa, hakisan dan lembangan

Peninsula | weathering, erosion and basins

Dalam Kenozoik, daratan Semenanjung terus mengalami luluhawa dan hakisan. Pada masa yang sama, sedimen terkumpul dalam lembangan tertentu, termasuk lembangan daratan seperti Batu Arang dan lembangan luar pesisir. Tertier ialah istilah lama yang merangkumi Paleogen dan Neogen, sebelum Kuaterner.

During the Cenozoic, the Peninsula continued to undergo weathering and erosion. At the same time, sediment accumulated in selected basins, including inland basins such as Batu Arang and offshore basins. Tertiary is an older term covering the Palaeogene and Neogene, before the Quaternary.

Melaka | laterit ialah hasil perubahan batuan

Melaka | laterite records rock alteration

Air dan iklim tropika mengubah mineral batuan, sementara larut resap menyingkirkan sebahagian bahan dan mineral besi boleh tertumpu. Profil laterit Melaka merekodkan proses ini. Usia batuan induk tidak sama dengan usia laterit; pembentukan dan pengubahannya boleh berterusan merentasi beberapa tempoh geologi.

Water and tropical conditions alter rock minerals, while leaching removes some material and iron minerals may become concentrated. Melaka's lateritic profiles record these processes. The age of the parent rock is not the age of the laterite; formation and modification may continue across several geological intervals.

8 | Kuaterner: garis pantai berpindah

Quaternary: shifting shorelines



Ilustrasi konsep / Conceptual illustration — sungai, muara dan pesisir / river, estuary and coast

Semenanjung | 2.58 juta tahun dahulu hingga kini

Peninsula | 2.58 million years ago to the present

Kuaterner merangkumi Pleistosen dan Holosen. Kitaran glasier mengubah jumlah air yang tersimpan sebagai ais, lalu mengubah aras laut dan keluasan daratan terdedah di Pentas Sunda. Apabila aras laut berubah, sungai, muara dan kawasan pemendapan turut menyesuaikan kedudukannya.

The Quaternary comprises the Pleistocene and Holocene. Glacial cycles changed the amount of water stored as ice, altering sea level and the extent of exposed land on the Sunda Shelf. Rivers, estuaries and depositional zones shifted as sea level changed.

Melaka | bukti pantai lama dan lembah sungai

Melaka | evidence of former coasts and river valleys

Endapan Kuaterner penting di lembah Sungai Linggi dan Sungai Melaka. Permatang pasir pantai di pesisir serta lebih jauh ke darat merekodkan kedudukan pantai Holosen terdahulu. Holosen bermula kira-kira 11,700 tahun dahulu; sejarah Kesultanan Melayu Melaka berada dalam bahagian yang sangat akhir pada garis masa ini.

Quaternary deposits are important in the Linggi and Melaka river valleys. Coastal sand ridges along the shore and farther inland record former Holocene coastlines. The Holocene began about 11,700 years ago; the Melaka Sultanate occupies a very late part of this timeline.

9 | Gula dan Beruas: masa hampir sama

Gula and Beruas: broadly overlapping time



Ilustrasi konsep / Conceptual illustration — dataran sungai / river plain

Semenanjung | dua nama, sekitaran berbeza

Peninsula | two names, different environments

Formasi Gula lazimnya mewakili endapan laut hingga muara, termasuk lempung, lodak dan pasir. Formasi Beruas pula banyak dikaitkan dengan aluvium muda, sungai serta paya daratan. Kedua-duanya sebahagian besar sezaman dalam Holosen; perbezaan nama tidak semestinya bermaksud satu sentiasa lebih tua daripada yang lain.

The Gula Formation generally represents marine to estuarine deposits, including clay, silt and sand. The Beruas Formation is commonly associated with young alluvium, rivers and inland swamps. They are largely contemporaneous within the Holocene; different names do not necessarily mean that one is always older than the other.

Melaka | sedimen menutup batuan lama

Melaka | sediment covers older rocks

Dossier mengenal pasti endapan Gula di Sungai Rambai serta endapan muda di lembah dan pesisir Melaka. Buku rujukan turut menghuraikan Beruas di lembah Sungai Linggi dan Sungai Melaka. Hubungan antara endapan daratan dan laut berubah mengikut lokasi, kedudukan pantai dan bekalan sedimen.

The dossier identifies Gula deposits at Sungai Rambai and young sediments in Melaka's valleys and coastal areas. The reference book also describes Beruas deposits in the Linggi and Melaka river valleys. Relationships between terrestrial and marine deposits vary with location, shoreline position and sediment supply.

10 | Batuan tua, pelabuhan yang lebih muda

Ancient rocks, a much younger port



Ilustrasi konsep / Conceptual illustration — pelabuhan silam / an imagined historic harbour

Skala geologi | berjuta-juta tahun

Geological scale | millions of years

Pembentukan sedimen asal, metamorfisme dan rejahan granit berlaku jauh sebelum kewujudan bandar Melaka. Luluhawa serta hakisan kemudian menghasilkan tanah, laterit dan sedimen yang membentuk persekitaran kehidupan manusia. Batu yang digunakan dalam bangunan boleh jauh lebih tua daripada bangunan itu sendiri.

Original sediment deposition, metamorphism and granite intrusion occurred long before Melaka town existed. Weathering and erosion later produced soil, laterite and sediment that shaped the human environment. Stone used in a building may be far older than the building itself.

Skala sejarah | beberapa abad terakhir

Historical scale | the last few centuries

Apabila Melaka berkembang sebagai pelabuhan pada sekitar 1400, manusia memanfaatkan sungai, pesisir dan sumber tempatan yang telah terbentuk. Geologi menyediakan keadaan fizikal; jaringan perdagangan, pentadbiran dan masyarakat membentuk tamadun. Tarikh 1511 atau 1957 menandakan peristiwa manusia, bukan permulaan unit batuan baharu.

When Melaka developed as a port around 1400, people used existing rivers, coasts and local resources. Geology provided the physical setting; trade networks, administration and communities shaped civilisation. Dates such as 1511 or 1957 mark human events, not the beginning of new rock units.

11 | Zum masuk: Melaka kebelakangan ini

Zooming in: Melaka in recent history



Rombongan kemerdekaan, 20 Februari 1956. / Independence delegation, 20 February 1956. Foto: Arkib Negara Malaysia.

Sekitar 1400 | Kesultanan Melayu Melaka

Around 1400 | The Melaka Sultanate

1511 | Portugis menawan Melaka

1511 | Portuguese capture of Melaka

1641 | Belanda menawan Melaka dengan bantuan Johor

1641 | Dutch capture with support from Johor

1824 | Melaka diserahkan kepada British melalui perjanjian

1824 | Melaka transferred to Britain by treaty

1942-1945 | Pendudukan Jepun; British kembali pada 1945

1942-1945 | Japanese occupation; British return in 1945

1956-1957 | Pengumuman tarikh, kemudian kemerdekaan

1956-1957 | Date announced, followed by independence

1963 hingga kini | Melaka dalam Malaysia

1963 to the present | Melaka within Malaysia

Semua peristiwa sejarah ini berlaku dalam Holosen, bahagian terkini Kuaterner.

All these historical events fall within the Holocene, the most recent part of the Quaternary.

12 | Hari ini masih sebahagian geologi

Today is still part of geological time



Ilustrasi konsep / Conceptual illustration — pesisir yang terus berubah / a continually changing coast

Proses lama, perubahan yang berterusan

Ancient processes, continuing change

Hujan masih meluluhawakan batuan. Sungai membawa sedimen, manakala ombak dan arus menyusun semula pasir serta lumpur pantai. Kerja pembangunan dan penambakan turut mengubah pesisir. Landskap Melaka hari ini ialah hasil sejarah geologi yang panjang dan tindakan manusia yang jauh lebih terkini.

Rain continues to weather rock. Rivers transport sediment, while waves and currents redistribute coastal sand and mud. Development and reclamation also modify the shore. Today's Melaka landscape combines a long geological history with much more recent human activity.

Apabila melihat singkapan, tanah, muara atau bangunan lama, kita sebenarnya melihat rekod dengan usia yang berlainan di satu tempat. Inilah hubungan utama garis masa Semenanjung Malaysia, geologi Melaka dan sejarah Melaka.

An outcrop, soil profile, estuary or historic building can preserve records of different ages in one place. This is the central connection between Peninsular Malaysia's timeline, Melaka's geology and Melaka's history.

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