September 20, 2021

News and notes

Before going on to complete the discussion on sedimentary depositional environments, let's go over a few items from the news that I think are interesting.

- Stunning time-lapse video of eruption of an eruption at the Teneguía Volcano on the island of La Palma in the Canary Islands. Also: Thousands Evacuated as Canary Island Volcano Erupts. This for the Darwin Awards: Devastating volcano eruption can be used to lure tourists to Canaries, says minister.

- Popocatépetl Volcano outside Mexico City is spewing ash again: Popocatépetl Volcano Volcanic Ash Advisory: CONTG OCNL VA EMS to 20000 ft (6100 m). The current estimated population of Greater Mexico City area is 21.2 million people, making it the largest metropolitan area in the western hemisphere.

- Also in Mexico: Landslides from the 7 September 2021 M=7.1 Guerrero earthquake in Mexico.

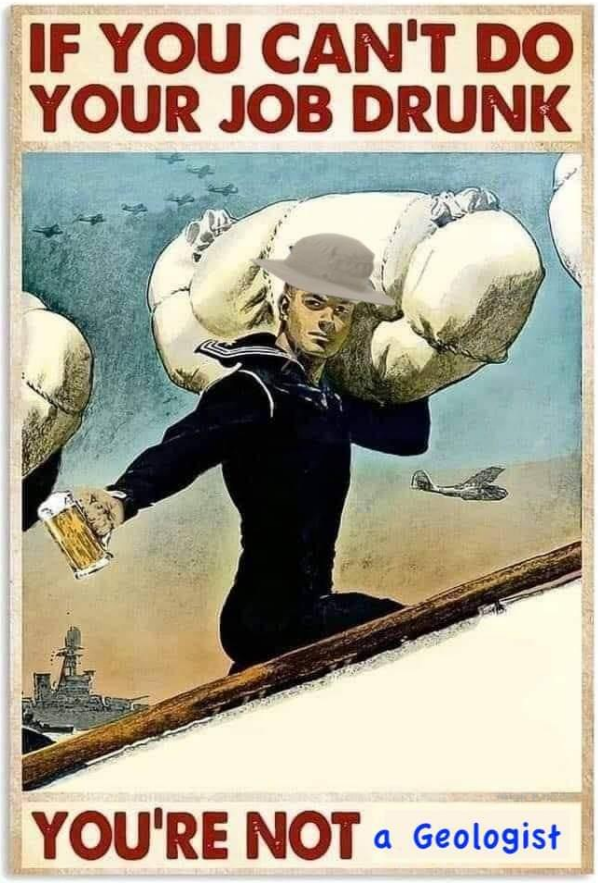
- Just a reminder that our current Quaternary Ice Age is not the only one in Earth's history; research in the glaciation that occurred during the Late Paleozoic: Fjord network in Namibia: A snapshot into the dynamics of the late Paleozoic glaciation. Also: Fossil Fjords in Namibia.

- Following upon last week's discussion on coral reefs: Scientists Complete the First Map of the World's Coral Reefs.

- Scientists want to resurrect the woolly mammoth. They just got $15 million to make it happen. A lesson from fiction, "so preoccupied with whether or not they could, they didn't stop to think if they should".

- Lori Stewart, P.Geo. and I co-wrote an article on silver for the Fall 2021 edition of the Keystone Professional, newsletter of Engineers Geoscientists Manitoba. It's on page 22 of the newsletter.

- Finally, seen on Facebook:



September 20, 2021

Depositional Environments for Sedimentary Rocks, Part 9, Deep Sea Deposits

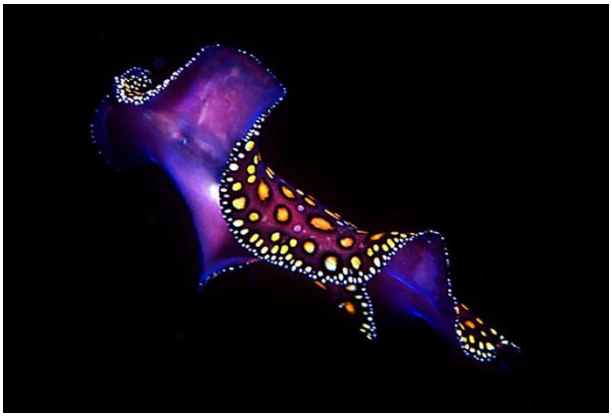


Figure 1 - Abyssal Zone Organism
Credit: Abyssal zone organisms. Hadal zone:
Ten things you never knew about the ocean's deepest places

We're going to wind up the discussion on sedimentary depositional environments with a look at deep sea environments of the continental slopes and the abyssal plains, as in Table 1.

Table 1 Marine Depositional Environments

Environment	Key Transport Processes	Depositional Settings	Typical Sediments
Deltaic	Moving water	Deltas	Sand, silt, clay, organic matter
Beach	Waves, long-shore currents	Beaches, spits, sand bars	Gravel, sand
Tidal	Tidal currents	Tidal flats	Fine-grained sand, silt, clay
Reef	Waves, tidal currents	Reefs and adjacent basins	Carbonates
Shallow marine	Waves, tidal currents	Shelves, slopes, lagoons	Carbonates in tropical climates; sand/silt/clay elsewhere.
Lagoonal	Little transportation	Lagoon bottom	Carbonates in tropical climates, silt, clay
Submarine fan	Underwater gravity flows	Continental slopes, abyssal plains	Gravel, sand, silt, clay
Deep water	Ocean currents	Deep-ocean abyssal plains	Clay, carbonate mud, silica mud

Underwater Gravity Flows and Turbidites

The term "underwater gravity flows" is a bland technical name for a fairly dramatic event sometimes called an underwater landslide or avalanche. While covered by the sea, the consequences of an underwater gravity flow can be significant. As discussed in my post of March 29, 2021, the most important consequence of an underwater avalanche can be a tsunami. The underwater stream follows the thalweg, the lowest part of the valley, and carries a load of gravel, sand, silt and clay that forms a turbidite deposit. Figure 2 shows the flow of a underwater gravity flow forming a turbidite deposit.

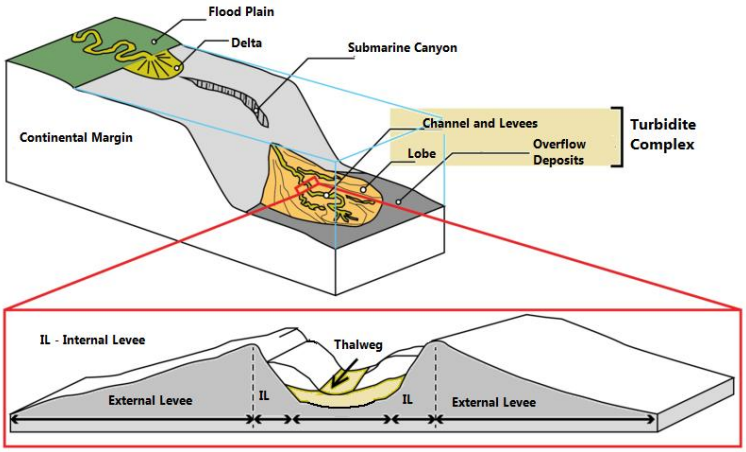


Figure 2 - Turbidite Formation

Turbidites are characterized by graded bedding where the coarsest sediments, pebbles and cobbles, are found at the bottom of the series. The material becomes progressively finer as you go up the series. This is as a result of the energy involved in the deposition of a turbidite. In the earliest phase, during the violent energy of the landslide, only coarse sediments are deposited. As the landslide plays itself out, the finer material can be deposited.

The picture in Figure 3, below, shows a rock wall in Death Valley National Park near Mesquite Springs. The turbidites exposed in Death Valley are Tertiary aged sediments. As result of tectonic activity, the land was uplifted, a stream eroded through the sediments and the turbidites were exposed.

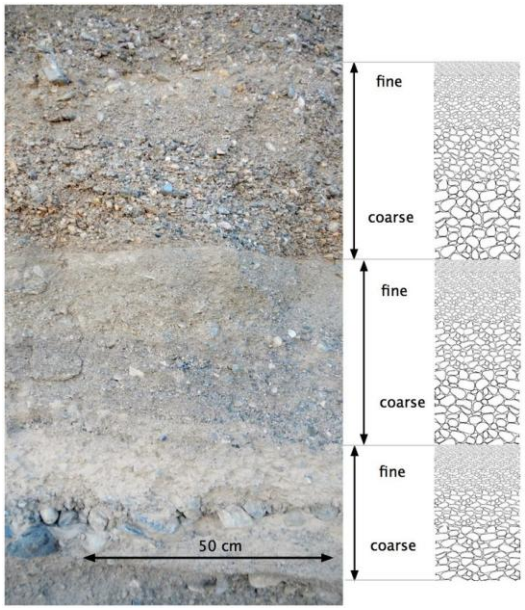


Figure 3 - Graded Bedding in a Turbidite

The underwater gravity flows that deposit turbidites carry not only pebbles, gravel, sand, silt and clay, they can also carry the remains of any living organisms that happened to be present in the submarine canyon when the landslide took place. The underwater avalanche can carry the remains of these creatures far out to sea where they can be deposited in low oxygen, or anaerobic, conditions - ideal for fossilization. A spectacular example of this is in the Burgess Shale, a Cambrian aged formation in Yoho National Park, British Columbia. Figure 4 shows one of these wonderful fossils.

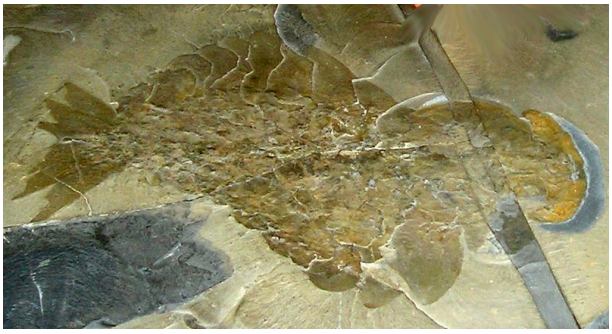


Figure 4 - Anomalocaris Fossil

The Burgess Shale Geoscience Foundation manages the Burgess Shale site and arranges for guided tours of the quarries where the fossils were recovered.

Deep-ocean Abyssal Plain Deposits

As noted in Table 1, the abyssal plains are the repositories of clay, carbonate mud, silica mud and manganese nodule deposits.

Marine shales, like the Burgess Shale, are often deposited in anaerobic conditions that preserve organic matter. This not only allows for the preservation of fossils, it can create the source rock for the development of petroleum deposits. Figure 5 shows an example of an oil bearing shale from Colorado, USA.

Figure 5 - Colorado Oil Shale

Carbonate mud is the source of chalk deposits. In the deep ocean, there are few sources of clastic material to deposit shale. However, there are tiny marine animals known as foraminifera (forams) and marine algae known as coccoliths. Forams and coccoliths grow shells made up of calcium carbonate. When these organisms dies, their shells drop to the bottom of the ocean and can accumulate as chalk deposits. A famous example of these are Cretaceous White Cliffs of Dover in the United Kingdom, Figure 6.

Figure 6 - The White Cliffs of Dover, U.K.
Credit: Fanny, Creative Commons Attribution-Share Alike 2.0 Generic license

Silica mud also forms from the remains the skeletons of microscopic organisms, in this case the siliceous skeletons of diatoms. While these remains sometimes form diatomaceous earth, under the right conditions, the diatom skeletons can dissolve and be re-deposited as flint and chert nodules in other deep sea deposits, such as chalk. Figure 7 shows flint nodules in a chalk deposit in East Sussex, United Kingdom.

Figure 7 - Flint Nodules in Chalk, East Sussex, U.K.
Credit: Dennis Turner, Creative Commons Attribution-Share Alike 2.0 Generic license

Manganese Nodules are a general term for mineral concretions found on the abyssal plain. These polymetallic concretions consist of concentric layers of iron and manganese hydroxide. The nodules often contain other metallic minerals such as cobalt, nickel and copper. There are serious proposals to mine these nodules for their mineral content, located at approximately 4,000 metres below the ocean surface! While the proponents of deep sea mining express the belief that extracting these nodules is a relatively benign operation, others worry about the destruction of unique life forms on the abyssal plain.

Since the bottom of the ocean is essentially an unregulated environment, I expect that manganese nodules will be exploited when it becomes profitable to do so. I also expect the exploitation of this resource to be conducted with ruthless efficiency and with little concern for the environment. Figure 8 shows a deep sea sponge with a field of manganese nodules in the background.

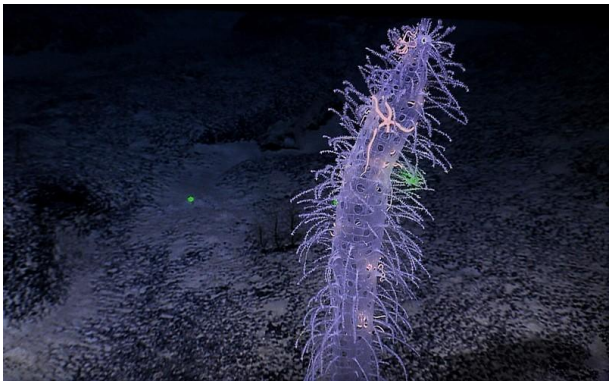


Figure 8 - Deep Sea Sponge with Manganese Nodules in the Background
Credit: Zhang Jiansong/Xinhua/Alamy

Standard Caveat

The purpose of my weblog postings is to spark people's curiosity in geology. Don't entirely believe me until you've done your own research and checked the evidence. If I have sparked your curiosity in the subject of this posting, follow up with some of the links provided here. If you want to, go out into the field and examine some rocks on your own with the help of a good field guide. Follow the evidence and make up your own mind.

In science, the only authority is the evidence.