August 23, 2021

News and Notes

Here are a few news stories that I found interesting this week, along with some commentary:

- Three volcanoes in the Aleutian Range of Alaska erupted at roughly the same time recently. This isn't an entirely unusual occurrence, three volcanoes in Alaska erupted in 1986. The Aleutian Range in Alaska overlies the Alaska-Aleutian Subduction Zone, one of the most seismically active regions in the world.
- Other volcano news: on the Indonesian island of Sulawesi, Mount Lokon is now off-limits for tourists due to potential volcanic eruption; and near Iwo Jima, a volcano has created a new island.
- The new rulers in Afghanistan are sitting on a cornucopia of mineral resources. Here is a PowerPoint slide deck from the Afghanistan Geological Survey on the geology and mineral resources of their land. Any mining development will depend on the establishment of social order in the country, a difficult task in its own right.
- Among the mineral riches of Afghanistan are many gem grade mineral specimens.
- An interesting study from Japan. One of the sets of evidence for plate tectonics is the record of past magnetic north directions preserved in volcanic rocks. The scientific paper on this topic was published here.
- There's an app for that, the Geological Survey of India releases an app for Android devices to access their services. Most people in India who have access to the internet do so through their mobile devices.
- Review of a new book, *How the Mountains Grew* by John Dvorak. I haven't read it yet, it's on my wish list. Here is the link for the book at Amazon.ca.
- National Public Radio in the USA reports a labour shortage in the American mining business. More on that story here from ABC News. Boom and bust cycles in resource extraction industries encourage workers to "take the money and run" to a more stable livelihood. It's a game for the young.

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Depositional Environments for Sedimentary Rocks, Part 7, Shoreline Environments

Figure 1 - Waikiki Beach at Sunset
Credit: Cumulus Clouds, GNU Free Documentation License, Version 1.2

This week we're going look at shoreline environments: beaches and tidal flats, as in Table 1, below.

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

Types of Beaches

Beaches can be classified according to the grain size of the material that makes up the beach, as in the Wentworth Grain Size Classification shown in Table 2.

Table 2 - Wentworth (1922) Grain Size Classification

Millimeters (mm)	Micrometers (μm)	Phi (ϕ)	Wentworth size class	
4096		-12.0	Boulder	Gravel
256		-8.0	Cobble	
64		-6.0	Pebble	
4		-2.0	Granule	
2.00		1.0	Very coarse sand	Sand
1.00		0.0	Coarse sand	
1/2 0.50	500	1.0	Medium sand	
1/4 0.25	250	2.0	Fine sand	
1/8 0.125	125	3.0	Very fine sand	
1/16 0.0625	63	4.0	Coarse silt	Silt
1/32 0.031	31	5.0	Medium silt	
1/64 0.0156	15.6	6.0	Fine silt	
1/128 0.0078	7.8	7.0	Very fine silt	
1/256 0.0039	3.9	8.0	Clay	Mud
0.00006	0.06	14.0		

After Wentworth, C.W., 1922 [1]

I've divided the scale into three general classifications: Mud & Silt, Sand, and Gravel. In general, the grain size of the beach will reflect the energy regime. High energy environments, i.e. places with regular heavy swells crashing on the beach, will be made up of coarse grained material like pebbles and cobbles. Moderate energy environments, i.e. places with regular off shore currents and moderate wave action, will build sandy beaches and off-shore sand bars. Low energy environments with little wave action will result in deposits of mud and silt. Figure 2 illustrates the energy regimes at coastal environments.

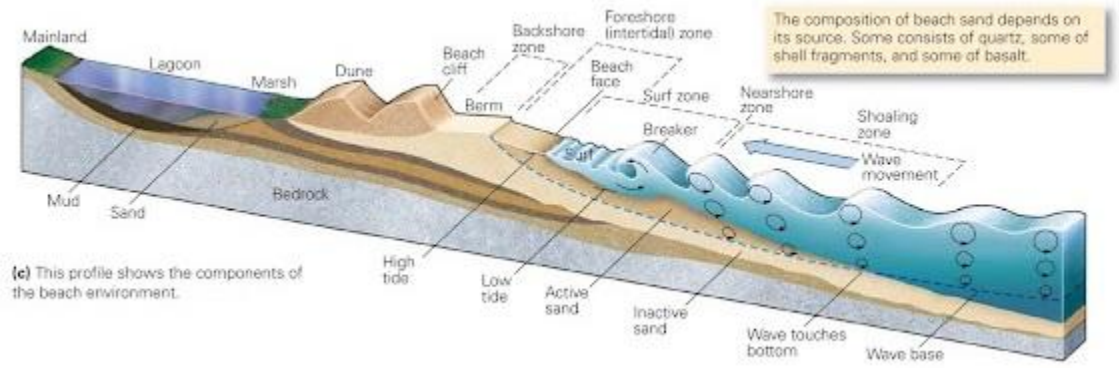

Figure 2 - Coastal Energy Environment
Credit : Learning Geology

Tidal Flats: Mud and Silt

Figure 3 - Tidal Flats and Salt Marsh on Grimsay, United Kingdom
Credit: Gordon Hatton, Creative Commons Attribution-Share Alike 2.0 Generic license.

Tidal flats and salt marshes are low energy environments where silt and mud are likely to be deposited. Tidal flats and salt marshes are generally protected by some sort of off-shore feature such as sand bars or a narrow estuary entrance that absorb wave energy before it reaches the tidal flats and salt marshes. A typical location for a salt marsh or tidal flats is within a lagoon or an estuary.

Tidal flats often have abundant shell fish such as clams and crustaceans living in the mud. Sea birds, such as sandpipers and plovers, depend on the crustaceans living in mud flats for their sustenance. People collect clams and other shell fish for food in tidal flats. Salt marshes are important "nurseries" for fish where they can grow in relative safety from predators.

Sandy Beaches and Sand Bars

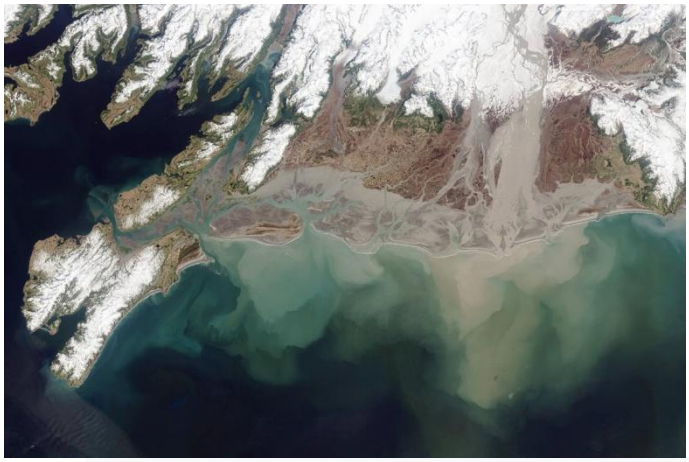

Figure 4 - Sediment Distribution Along the Alaskan Coast
Credit: NASA Satellite Image, public domain

When sand is deposited in the ocean from rivers and other runoff from the land, it is constantly re-worked by various currents. An important kind of current is the long-shore current shown in Figure 5.

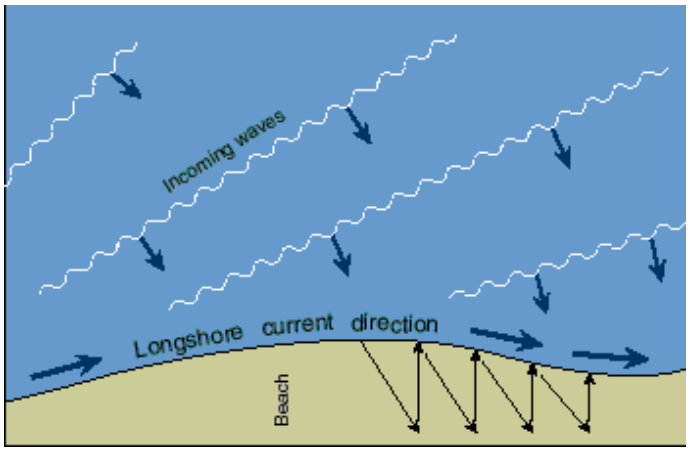

Figure 5 - Long-shore Current
Credit: USGS, public domain

In long-shore currents, waves hitting the beach at an angle return in a different direction. This sets up a current that can transport sand along the shoreline and can deposit the sand into long features such as spits and barrier islands, as shown in Figure 6.

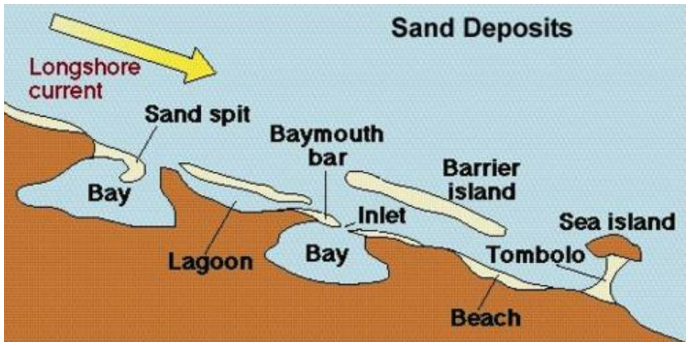

Figure 6 - Longshore Deposition
Credit: QS Study

Gravel Beaches

Figure 7 - Dieppe Beach, August 19th, 1942
Credit: Canadian Dept. of National Defence, public domain

Gravel beaches are deposited in high energy coastal environments. A typical pebble beach has a source of rock, such as a cliff, to be eroded by wave action. Heavy wave action will remove the smaller sized grains, such as sand, silt and clay leaving only gravel and pebbles. Without the smaller clastic grains, the gravel and pebbles will not stick together, that is, the grains will have little cohesion.

Walking on a pebble beach is a bit slippery, trying to operate a vehicle is next to impossible. The 14th Canadian Army Tank Regiment (the Calgary Tanks) found this out on August 19th, 1942 when the Calgary Tanks, along with other units of the 2nd Canadian Division and attached British, American and Free French Commandos, stormed across the pebble beach at Dieppe, France. Operation Jubilee, an assault across the beach, proved to be a doomed exercise.

The cliffs at Dieppe were manned by waiting German troops from various units. The assault proved to be a bloodbath. Among the 5,000 men of the 2nd Canadian Division who landed at Dieppe, 1,400 were killed and 1,946 were captured. Among the 1,000 British Commandos, 247 men were lost. Of the 50 US Army Rangers attached to the British Commando units, six were killed, seven wounded and four captured. The Royal Air Force lost 106 aircraft, although 20 pilots were rescued. The Royal Navy lost one ship, HMS Berkeley, losing 550 men. The Germans suffered 591 casualties, 322 fatal and 280 wounded, as well as losing 48 aircraft and one patrol boat.

The natural world puts hard limits on what we can and cannot do. Failure to understand these limits can have severe, even fatal consequences. Apologists for the Dieppe raid and its instigator, Lord Louis Mountbatten, claim that it provided important lessons for the later invasion at Normandy in 1944. One important lesson was that a proper understanding of the battle terrain was essential. That this lesson needed to be re-learned, a cursory understanding of military history is sufficient to see its importance, is a damning incitement of the so-called military experts in charge of Operation Jubilee. It is significant that after the Dieppe raid, Lord

Mountbatten was relieved of his duties as head of Combined Operations and shuffled off to India to lead the South East Asia Command.

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.

References

1. Wentworth, C.W., 1922, *A Scale of Grade and Class Terms for Clastic Sediments*, The Journal of Geology, Vol. 30, No. 5 (Jul. - Aug., 1922), pp. 377-392, University of Chicago Press, https://www.jstor.org/stable/30063207