January 23, 2033

News and notes

Before looking at the events at the end of the Pleistocene Epoch, specifically the Younger Dryas Event, here are a few news items that I thought were interesting.

Research

- Digging holes through soil: Mechanistic framework for reduced-order models in soft materials: Application to three-dimensional granular intrusion; Eureka Alert summary here.
- Sedimentology: Grain shape effects in bed load sediment transport; Eureka Alert summary here.
- More sedimentology: Identifying sources of non-unique detrital age distributions through integrated provenance analysis: An example from the Paleozoic Central Colorado Trough.
- Stratigraphy: Modelling parametric uncertainty in large-scale stratigraphic simulations.

Plate Tectonics

- Variations in Lithospheric Thickness Across the Denali Fault and in Northern Alaska; Phys.org summary here.
- Mineralogy and plate tectonics: Slab window–related magmatism as a probe for pyroxenite heterogeneities in the upper mantle.
- The Montello Thrust and the Active Mountain Front of the Eastern Southern Alps (Northeast Italy); Phys.org summary here.

Geochemistry

- Ocean geochemistry and the carbon cycle: The Outsized Role of Salps in Carbon Export in the Subarctic Northeast Pacific Ocean; Phys.org summary here.
- More geochemistry, natural sequestering of toxic metals: Trace Element Geochemistry in the Earliest Terrestrial Ecosystem, the Rhynie Chert; Phys.org summary here.
- Fluvial geochemistry and the carbon cycle: River ecosystem metabolism and carbon biogeochemistry in a changing world; Phys.org summary here.

Paleontology

- Remains from Ocean Anoxic Event 2, 100 Mya, from Phys.org: Malformed seashells, ancient sediment provide clues about Earth's past; scientific papers here and here.
- Coprolites: Ancient poop offers unusual insight into animal behaviour.
- Fossilized feathers: Taphonomic analysis of the exceptional preservation of early bird feathers during the early Cretaceous period in Northeast China; Phys.org summary here.
- Trilobite combat: Trilobite tridents demonstrate sexual combat at 400 Mya.

- Dinosaurs: New Late Cretaceous titanosaur sauropod dinosaur egg clutches from lower Narmada valley, India: Palaeobiology and taphonomy; Eureka Alert summary here.
- More dinosaurs: Ornithischian dinosaurs in Southeast Asia: a review with palaeobiogeographic implications.
- Insects in amber: A new remarkable cimicoid genus and species (Hemiptera, Heteroptera, Cimicomorpha) from mid-Cretaceous Burmese amber, with implications for its aberrant male genitalia.
- More insects in amber: A new genus of dance fly (Diptera: Empidoidea: Hybotidae) from Cretaceous Spanish ambers and introduction to the fossiliferous amber outcrop of La Hoya (Castellón Province, Spain)

Glaciers and Climate Change

- Seasonal temperatures in West Antarctica during the Holocene: Science Daily summary here.
- African dust and Antarctic glaciers: South African dust contribution to the high southern latitudes and East Antarctica during interglacial stages; Phys.org summary here.
- Early glacier advance in New Zealand during the Antarctic Cold Reversal.
- Ocean currents and glaciers: AMOC Stabilization Under the Interaction With Tipping Polar Ice Sheets; this is related to the discussion of the Younger Dryas below.

Environmental Geology and Hydrogeology

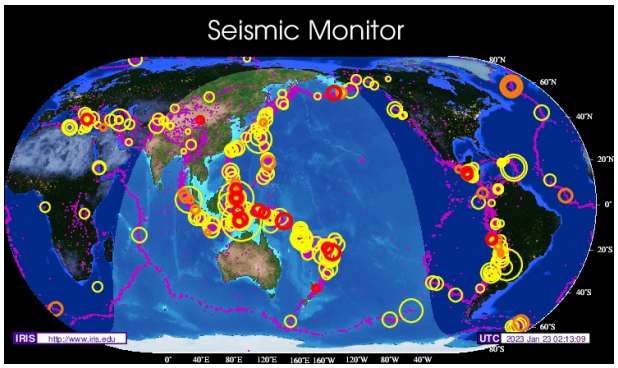
- Plastic pollution: Soil and freshwater come under the spotlight in plastics-pollution fight.
- More on plastic pollution: Satellite monitoring of terrestrial plastic waste; Phys.org summary here.
- Heavy metal pollution in Zambia: Court told Anglo turned blind eye to Zambian lead poisoning.
- Groundwater flow: Revisiting Mt Fuji's groundwater origins with helium, vanadium and environmental DNA tracers; Phys.org summary here.

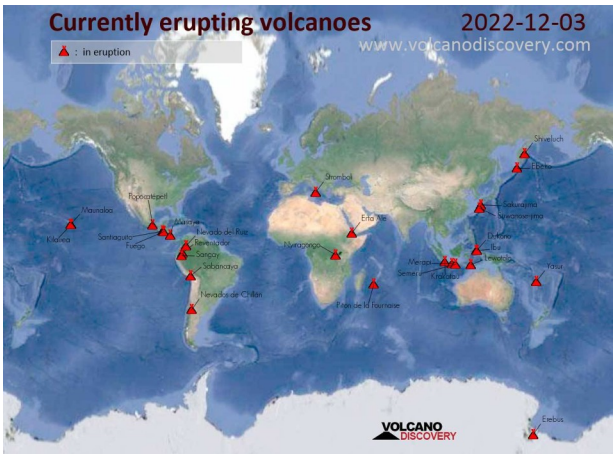
Energy and Mining

- Commentary: Ottawa denies natural gas to another trading partner and perpetuates fictitious agenda – Fraser Institute – Kenneth P. Green.
- Oil Rises a Second Week as Chinese Buying Spree Buoys Market.
- Exploration: U.S. oil rig count falls this week by most since Sept 2021 – Baker Hughes.
- From the United States Energy Information Administration (USEIA): Increasing renewables likely to reduce coal and natural gas generation over next two years.
- Also from the USEIA: Russia's Energy Overview and Drilling Productivity Report.

- UK activates coal reserve to boost supply during cold snap.
- Evaluation insight into Abu Zenima clay deposits as a prospective raw material source for ceramics industry: Remote Sensing and Characterization.
- Seafloor mining, from Insider Business on YouTube: Rocks Vacuumed Off The Deep Seafloor Can Power Electric Cars. But Is It Worth It? Big Business.
- From Mining.com: The risks of plundering the periodic table.
- Also from Mining.com: Peru unrest threatens to choke off almost 2% of global copper supply and Gold price backs off on rising dollar, but set for fifth weekly rise.

Volcanoes, Earthquakes and Geohazards





Seismic Monitor Link **Currently Erupting Volcanoes**

- After the volcano: The Early Microbial Colonizers of a Short-Lived Volcanic Island in the Kingdom of Tonga; Eureka Alert summary here.
- From the United States Geological Survey (USGS): Newberry Volcano Is an Impressive but Unappreciated Giant.
- Lava research: Making sense of brittle deformation in rhyolitic lavas: Insights from Obsidian Dome, California, USA.
- More lava research, ocean island basalts: Long-term core–mantle interaction explains W-He isotope heterogeneities.
- Geohazards: Flood forecasts in real-time with block-by-block data could save lives – a new machine learning method makes it possible.

Neat Stuff

- From Geology In: Salt Domes And Salt Glaciers of Zagros Mountains.

Upcoming Events

Department of Earth Sciences

The Jack Gallagher Visiting Scientist 2023
Dr. Jen Russel Houston

Dr. Jen Russel-Houston is a petroleum geologist and the Vice President of Geoscience at Tenaz Energy, a position she has held since the company's creation in 2021. Tenaz is an energy company focused on the acquisition and sustainable development of international oil and gas assets and development of a semi-conventional oil reservoir in the Upper Mannville in central Alberta. She was VP Geoscience and Land at Osum Oil Sands from 2014 to 2021. Prior to that, she led technical teams at Osum and Shell Canada and worked as a petroleum geologist at Shell Canada.

Dr. Russel-Houston was President of the Canadian Society of Petroleum Geologists (CSPG) in 2020. Dr. Russel-Houston won the CSPG Link Award in 2010, the CSPG Medal of Merit in 2015, and was the 2016 Halbouty Distinguished Lecturer at the Geological Society of America. She holds a Bachelor of Science (Honours) degree from Queen's University, a Bachelor of Education from University of Ottawa, a Doctorate in Earth Science from Dalhousie University, and is a professional geologist with the Association of Professional Engineers and Geoscientists. Please join us as Dr. Jen Russel-Houston shares her expertise with Manitoba geoscientists for her upcoming lecture series as noted below.

Thursday, February 2, 2023 at 1:00 p.m., 223 Wallace Building, University of Manitoba

"Sleeping Giant: Bitumen Reservoirs in the Paleokarsted Carbonates of the Grosmont Formation in Northern Alberta"

Friday, February 3, 2023 at 9:30 a.m., 217 Wallace Building, University of Manitoba

"Career Pathway" *(This presentation is geared for Undergraduate Students)*

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Events of the Quaternary Period – The Younger Dryas Event

Figure 1 – *Dryas* flower in Nunavut, Canada
Credit: Qaqqaqtunaaq, Creative Commons Attribution 2.0 Generic license

The Younger Dryas Event at the end of the Pleistocene lasted from approximately 12,900 to 11,700 years before present (BP). It is an interesting story. The transition form the Pleistocene to the Holocene was anything but gentle and involved drastic climate change and the extinction of many species, especially the so-called Pleistocene megafauna. During the Younger Dryas Event average temperatures in the Northern Hemisphere dropped by 10°C within a few years, possibly less than a decade.

Discovery and Definition

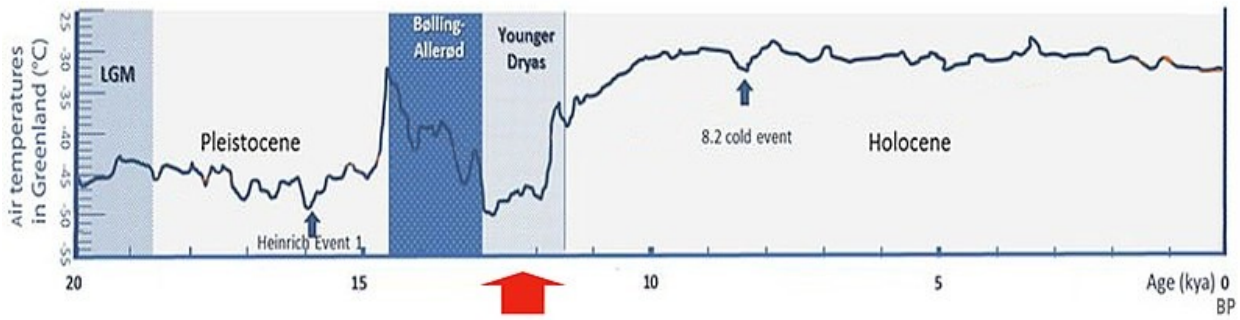

Figure 2 – Evolution of temperature in the Post-Glacial period according to Greenland ice cores
Credit: Figure 5 in Platt *et al*, 2017, Creative Commons Attribution-Share Alike 4.0 International license

During the early 20th Century, Swedish and Danish researchers (links here and here) noticed that there were concentrations of pollen from the *Dryas octopetala* flower at three distinct intervals that they called the Younger Dryas, the Older Dryas and the Oldest Dryas. Each of these events were stadials, distinct periods of colder climate.

The Oldest Dryas occurred between 15,070 and 14,670 years BP and the Older Dryas occurred about 14,000 years BP and lasted about 200 years. The Older and Oldest Dryas events occurred within the Bolling and Allerod interstadials which are sometimes lumped together in the Late Glacial Interstadial. The Younger Dryas was the longest, and most severe of the three stadials, occurring between 12,800 and 11,500 years BP.

The studies of pollen and vegetation from deposits dating from the Late Pleistocene indicate severely cold conditions during the Younger Dryas. These colder conditions were almost as cold as those during the Late Glacial Maximum, approximately 27,000 to 20,000 years BP. Not only did the climate worsen during the Younger Dryas but many species of megafauna became extinct during the coincident Quaternary Extinction Event.

Figure 3 – Pleistocene Megafauna
Credit: Mauricio Antón, Creative Commons Attribution 2.5 Generic license

Causes – What Happened?

You could argue that the Quaternary Extinction Event and the Younger Dryas Event are separate events. The most common causes of cited for the Quaternary Extinction Event include:

- Over hunting by humans;
- New diseases introduced by migrating humans; and
- Climate change, i.e the Younger Dryas Event.

While all of these factors, and possibly others not listed here, were involved in the Quaternary Extinction Event; the elephant in the room, or perhaps woolly mammoth, is the tremendous and sudden cooling that occurred during the Younger Dryas Event 12,800 years BP. So what do we think caused the Younger Dryas.

The proximate cause of the Younger Dryas appears to have been a shut down of the thermohaline circulation of the North Atlantic whereby heat is transferred from the tropical regions to the northern latitudes. A sudden outflow of glacial meltwater from Lake Agassiz could trigger this breakdown of ocean circulation. The change in heat flow could also cause longer term changes in the climate leading to a long term cooling. The initial trigger of the glacial meltwater outflow could have been a solar flare or an even more spectacular Younger Dryas Impact Hypothesis. A recent paper discusses the interaction of glaciers and ocean currents.

The Younger Dryas Impact Hypothesis

Figure 4 – An earth-shattering Kaboom
Credit: NASA, public domain

The Younger Dryas Impact Hypothesis is one of the most interesting explanations for the cause of the Younger Dryas. Briefly, the hypothesis suggests that an extraterrestrial bolide (comet, asteroid, or meteor) impacted the Earth, landing on the Laurentide Ice Sheet. The heat of the impact melted part of the glacier and the meltwater. First suggested in 2007, the main evidence for the theory includes:

- Impact debris such as microspherules, carbon spherules, magnetic spherules, iridium, platinum, platinum/palladium ratios, charcoal, soot, and fullerenes enriched with helium-3; and

- "Black mats", or strata of organic-rich soil that have been identified at about 50 archaeological sites across North America.

It is a controversial theory. Recent papers on the theory include:

- Premature rejection in science: The case of the Younger Dryas Impact Hypothesis;
- A multi-proxy study of changing environmental conditions in a Younger Dryas sequence in southwestern Manitoba, Canada, and evidence for an extraterrestrial event; and
- The Younger Dryas impact hypothesis: Review of the impact evidence.

You can really go down the rabbit hole on this one. Besides the scientific literature, these websites cover the Younger Dryas Impact Hypothesis extensively:

- The Human Origin Project: The Evidence for the Younger Dryas Impact Hypothesis;
- The Cosmic Tusk: The Younger Dryas Impact Hypothesis since 2007 and Alpine Younger Dryas Impact evidence;
- The Comet Research Group; and
- Randall Carlson; warning: this rabbit hole is particularly deep.

The End of the Pleistocene and Human Experience

We know that people were alive during the end of the Pleistocene, so did the events of that time affect human culture? In addition to the possible bolide strikes, the end of the Pleistocene included:

- Extinction of megafauna;
- A rise in sea levels and the consequent flooding of a great deal of land;
- The displacement of the people and animals that lived on the now flooded land.

People would have noticed these drastic changes and tried to explain them. Writing hadn't been invented 12,800 years BP so any cultural memory or explanation would have been through orally transmitted mythology. Among the many speculations, some people contend that the end of the Pleistocene inspired such things as:

- The myth of Noah's flood;
- The agricultural revolution of the Neolithic;
- The construction of Göbekli Tepe as a memorial;
- Numerous myths about gods and other supernatural entities; and
- The legend of Atlantis.

One writer who has stirred up some controversy researching this subject, and other ancient mysteries, is Graham Hancock. I think that he is a good writer and you don't have to agree with his conclusions to appreciate his questions. That many people disagree with Hancock and even wish to silence him is itself an endorsement to read his stuff.

Winding it Up

There's more if you care to look; it can be quite a journey. My suggestion for those who are interested in this hypothesis: read as much as you can, assess the evidence and make up your own mind. While I think that the hypothesis has some merit and that further research is justified; don't let that prejudice you.

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.