

Stories of the Lithosphere
Gold, Pollution, and Farmland--Cool Stuff
Earth Science Essentials
by Russ Colson

Geochemical Differentiation affects Life

The Tablelands of Newfoundland, Canada, are mostly barren of plants despite the fact that they get plenty of rain and the climate is moderated by the nearby presence of the sea. The Tablelands have few plants because the rock they are made of, called peridotite, contains enough Ni, Cr, Mg, Fe, and Co to be poisonous to plants. Peridotite is the stuff that Earth's mantle is made of and consists largely of olivine. Ni, Cr, Mg, Fe, and Co partition into the olivine rather than other minerals or magma. Pieces of this mantle material were thrust onto North America during plate tectonic convergence and later exposed by erosion.

Sometimes geologists have mapped underlying rock types that are not visible at the surface by noting where there are shifts in the proportions of particular plant types!

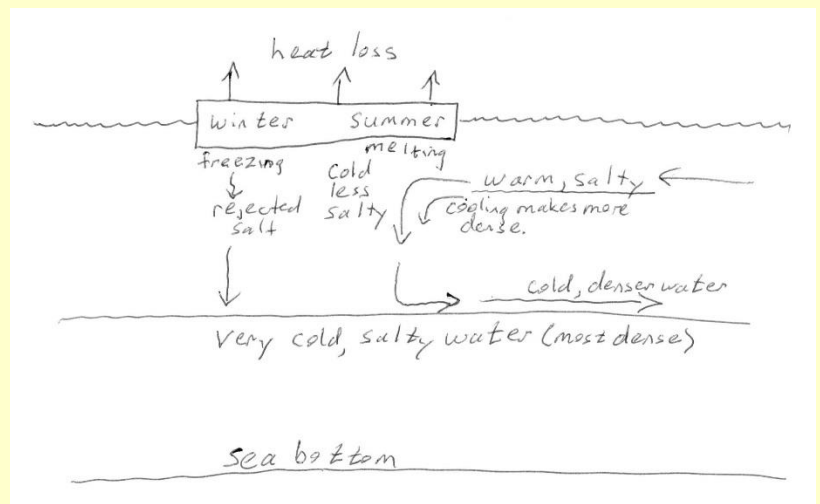
Migration and trade by ancient people has been tracked by observing the isotopic composition of fossil teeth or bone, which reflects the composition of the rock in the region their food and water came from which is different (differentiated) from every other region!

Geochemical Differentiation affects Climate

Salt partitions into liquid water in preference to ice. Thus when Ice freezes, the water remaining behind is saltier. Salt partitions into liquid water in preference to vapor. Thus, when ocean water evaporates, it leaves saltier water behind.

The result is that water moving toward the north pole is saltier than the surrounding polar water, both because there has been lots of evaporation from the water on its journey north and because the polar water is made fresher by the melting of the salt-depleted ice cap in summer.

Once this saltier water cools, it becomes denser and sinks. Freezing of water on the bottom of the ice cap in winter enhances the saltiness, causing even more sinking. Then, when the ice cap melts in spring, the water that results has had the salt removed, and is therefore fresher and less dense, ready to continue the cycle.



This sinking water in the Labrador and Greenland Seas is a key driver for the global circulation of ocean water that moves tropical heat to the poles and then recycles the cold arctic waters back to the equator. This movement of heat is a major part of Earth's climatic balance. For example, the movement of heat northward by the Gulf Stream is a key reason that the winters in Paris are significantly milder than Fargo ND which is near the same latitude, and the winters in London are milder than those in Saskatoon CA, near the same latitude. The sinking of ocean water at the pole also transports carbon dioxide (a greenhouse gas) from the atmosphere into storage in the deep ocean, thus acting as a buffer to changes in atmospheric carbon dioxide levels.

Geochemical Differentiation affects your Pets

If you have ever kept fish in an aquarium, you know that periodically you have to take out some of the water and add new water. If you don't add water, evaporation will gradually lower your water level. However, if you don't take out some of the water, then the water will grow saltier and saltier until all your plants and fish die.

Salt and other dissolved materials in the water mostly partition into the liquid rather than the vapor. This means that nearly all of the salts remain in the water, making the water saltier during evaporation.



If you simply added more water to replace the evaporation, then you are adding normal water (which contains some salts) to saltier water. Then more water evaporates, making the water saltier still. Eventually, the water would become saturated with salt and salt crystals would start to grow in your tank (long after all your pets died). Taking out some of the water when you add new water limits how salty that the water in your aquarium can get. When you remove water, you are removing some salt as well, unlike evaporation.