**Isle Royale National Park 2**

1. It is tempting to link the Lake Superior Syncline to the downward folded rocks of the Michigan Basin, …
2. … but the age of folding in the Michigan Basin is Paleozoic rather than Proterozoic and the style of deformation is different too. The bulls-eye pattern of rock ages indicates a bowl-like structure for the Michigan Basin …
3. ... whereas the Lake Superior Syncline is more like a long trough.
4. Because that trough is filled with a lot of relatively dense basalt, the pull of gravity is a little bit stronger there. The red areas on this map indicate where the pull of gravity is abnormally high. Note they form a belt that runs from Lake Superior southwestward across the heart of the Midwest. The gravity anomaly is particularly strong in central Iowa …
5. … where most residents are completely unaware of the oppressive gravitational hazard that lies below.
6. Sadly, there is little that can be done for the most severely affected.
7. The basalt-filled rift valley also shows up on magnetic surveys because basalt contains a lot of the highly magnetic mineral magnetite.
8. We have only recently become aware of how serious this environmental threat is.
9. Sedimentary rocks completely filled the failed rift, so there is little current topographic expression of the allochogen - other than Lake Superior where glacial erosion removed the rift’s softer sediments and helped form the deep basin now filled with the largest freshwater lake in the world.
10. During the interval when the rift was volcanically active, or shortly thereafter while those rocks were still warm, native copper deposits where emplaced.
11. The term native here implies that the copper is not compounded with any other element. Virtually pure copper is often found filling the amygdules …
12. … or just about any crack or pore in the basalt or conglomerate.
13. Some of the largest native copper masses ever found were mined from Isle Royale mostly in the 1870’s …
14. …. as well as several museum quality specimens that illustrate copper’s crystal habit and …
15. … variable forms.
16. Although no single theory for the origin of the copper deposits has been universally accepted, most involve the action of circulating hydrothermal solutions. These either brought copper-bearing solutions towards the surface from crystallizing magma at depth or leached the copper from the basalts themselves and re-precipitated it in pore spaces where the hydrothermal solutions cooled.
17. Throughout the Paleozoic, Mesozoic and Cenozoic the area was tectonically inactive and underwent a prolonged period of erosion …
18. … which essentially peneplaned the region. During the Pleistocene epoch, thick continental glaciers extended from Canada across this area …
19. … to as far south as central Illinois.
20. The direction in which the continental ice sheets moved across Isle Royale was almost exactly parallel to the strike of the Proterozoic basalts and conglomerate there.
21. So glacial erosion enhanced the island’s preexisting grain.
22. There are numerous places on the island where one can see where glacial action has polished ...
23. … or grooved rock surfaces.
24. As glaciers move across resistant rocks, asymmetrical ridges form because abrasion occurs on the side of ridge from whence the glacier comes (Stoss side), whereas ice plucking occurs on the Lee side. Such ridges are called Roche Moutonnée (rock sheep) …
25. … because they resemble sleeping sheep.
26. Supposedly, Roche Moutonnees formed along the most resistant lava flows of Isle Royale …
27. … but I could find no obvious examples.
28. Drumlins are another glacial landform which is alleged to exist on Isle Royale. Although they abound in nearby Wisconsin, again I could find no Isle Royale examples to show you.
29. They form in unconsolidated material - not rock, and they have the opposite asymmetry as Roche Moutonnees. The lee slope here is gentler.
30. Unlike the generally solitary Roche Moutonnees, drumlins typically occur in clusters.
31. Although glaciers where the dominant erosional agent which shaped the island, its shorelines were significantly modified by wave action.
32. Yes, there is surf in the Great Lakes! Remember that Lake Superior is the largest fresh water lake in the world …
33. … and some pretty viscous storms blow across it.
34. Believe it or not this is Lake Superior …
35. … and so is this ….
36. … and this. So you can see that there are days when wave erosion is going to be aggressive.
37. Wave eroded features occur on the most exposed shores and include sea cliffs, caves …
38. … and countless sea stacks, which are remnants of wave eroded points.
39. Because they where detached from the point by wave erosion, sea stacks tend to have steep sides.
40. Finally, wave erosion tends to level the shallow, near-shore lake bottom while building a gravel berm on the shore. When the water level drops and/or the land uplifts, these features are exposed indicating the position of the former shorelines.