

Outcomes Assessment for Geology 406

(Igneous and Metamorphic Petrology)

| Course Outcomes | Objectives (SWBAT) |
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| 1. Understand how observations are made (visual, geophysical, geochemical, etc.) and how those observations can be used to make inferences | 1.1 Students will be able to distinguish between an observation and an inference (assessed by field trip writeup) 1.2 Students will be able to describe a rock (observation only) and then be able to infer its origin based on their observations (assessed by field trip writeup) |
| 2. Understand how observations of rock characteristics and their classification can be used to interpret rock origin | 2.1 Students will be able to identify S-, I-, and A-type granitic rocks based on their mineral assemblage, and be able to describe the source from which they were melted 2.2 Identify the mineralogy of a metamorphic rock in order to determine its protolith 2.3 Students will be able to use mineral assemblages in different protoliths to determine the facies of metamorphism |
| 3. Students will understand how to identify, classify, and describe igneous and metamorphic rocks, both in the laboratory and in the field | 3.1 Identify and name igneous rocks and metamorphic rocks using a conventional naming protocol (assessed by field trip writeup and in lab) 3.2 Plot chemical compositions of igneous rocks on chemical classification diagrams (assessed by field trip writeup and/or lecture exam) 3.3 Identify the mineralogy of an igneous rock and use the appropriate IUGS classification for naming the rock (assessed in lab) 3.4 Identify the mineralogy of a metamorphic rock and plot on an appropriate compositional diagram (assessed in lab and lecture exam) |

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| <p>4. Understand how magmas are generated and how they change as they rise through Earth's crust (and become igneous rock).</p> | <p>4.1 Describe and/or draw on a P-T diagram the relationship between the geothermal gradient and a rock's solidus (either dry or wet). Interpret from this how magmas are generated in different tectonic settings.</p> <p>4.2 Read and interpret simple phase diagrams in order to describe how a magma crystallizes as it decreases in T</p> <p>4.3 Explain hypotheses for how magmas differentiate in Earth (crystal-liquid segregation, magma mixing, assimilation) and be able to recognize magma differentiation on a Harker diagram</p> <p>4.4 Explain how differences in crustal variables (e.g., thickness, composition) may effect the types of magmas erupted in different tectonic settings</p> |
| <p>5. Understand how rocks change through metamorphism, and how the metamorphic rock produced depends upon protolith, P-T conditions, and H₂O availability</p> | <p>5.1 Sketch the metamorphic facies on a P-T diagram.</p> <p>5.2 Name the assemblage that could form in each facies starting from a basalt or shale protolith.</p> <p>5.3 Describe how mineral assemblages change as you increase metamorphic grade in a carbonate and an ultramafic rock</p> |
| <p>6. Understand the relationship between types of igneous and metamorphic rocks and plate tectonic environments</p> | <p>6.1 Locate on a cross-sectional diagram of a plate margin where various igneous and metamorphic rock types would be expected.</p> |