Topic: Earth Materials: Minerals and Rocks **Week 3**

1.1 Classification of igneous rocks

Writing extended definitions

A. Read the following excerpt and using information from the text write an extended definition of the term *igneous rock* (not more than 90 words). Remember to use your own words!

Excerpt 1

Igneous rocks are derived from magma. Magma is molten rock material generated by partial melting of Earth's mantle and crust. Magma contains liquids, crystals, gases and rock fragments in varying proportions depending upon temperature, pressure and chemistry conditions. At temperatures over 1200 ° C, above the crystallization temperature of most minerals, magma tends to be enriched in liquids and dissolved gases.

Gas solubility in liquids is related to pressure. At high pressures in the lower crust and mantle, gases are readily dissolved in liquid magma. As magma rises towards Earth's surface, decompression causes gases to segregate from the melt as a separate phase. Opening a carbonated beverage container produces a similar reaction. When the bottle is capped, carbon dioxide gases are dissolved in the liquid under pressure. The removal of the bottle cap induces a pressure reduction such that gases segregate (exsolve) from the solution. This process, called *exsolution*, causes gas bubbles to develop, expand and rise towards the bottle top as a separate phase. In the same way, the liquid, solid and gas components within magma are largely dependent upon temperature and pressure conditions as well as the chemistry of the magma itself. Magma under high pressure conditions has a high volatile (dissolved gas) saturation point whereas magma under low pressure has a low volatile saturation point. We will look at these aspects further in this chapter when we consider non - crystalline rock textures.

With cooling, magma becomes progressively more enriched in solid material at the expense of liquid melt. Magma that solidifies within Earth produces intrusive or plutonic rocks. Intrusive rocks develop from magma that cools slowly within Earth producing large crystals visible to the eye. Plutons are magma chambers of various sizes, shapes and depths that store magma within Earth. The term "chamber" conjures images of a large room in which liquid magma is swishing around; this in fact is rarely the case. Because most magma is probably stored in rock fractures and pore spaces, plutons may contain relatively small amounts of melt at any given time.

Magma may rise towards Earth's surface due to its low density relative to rock. Magmatic gases provide additional force propelling magma upward in explosive, volcanic eruptions. In a sense, the dissolved gases within magma are analogous to jet fuel blasting a rocket from its launch pad. Magma that rises and erupts onto the surface of Earth is called *lava*. Lava reaches Earth's surface via vents generating flows and associated volcanic debris. *Volcanic* or *extrusive* igneous rocks form by solidification of lava and volcanic debris on Earth's surface, producing rocks with small crystals and/or non – crystalline particles of various sizes.

Igneous rocks are classified according to composition and texture. Composition is determined by magma chemistry. Texture refers to the size, shape, arrangement and degree of crystallinity of a rock's constituents. Together, these two sets of rock characteristics provide a means to classify rocks and to determine environmental conditions of rock formation.

Nearly all magmas are *silicate magmas*, enriched in the elements silicon and oxygen which bond together to form the silica tetrahedron. Rare examples of non - silicate magmas do exist. For example, carbonatite magmas, as their name suggests, are rich in carbonate minerals such as calcite. Silicate magmas contain anywhere from ~40% to over 75% silica (SiO_2). As silica is generally the dominant chemical component, magma and igneous rocks are classified as *ultrabasic, basic, intermediate* and *acidic* based upon percent SiO_2. Acidic rocks

are also referred to as *silicic*, based on their high SiO_2 content. In fact the terms acidic and basic are somewhat misleading as they have no reference to pH.

Magma chemistry determines the percentage of dark - colored or light - colored minerals. Dark - colored minerals are generally enriched in the elements iron and magnesium and are referred to as ferromagnesian or *mafic* minerals. Light - colored *felsic* minerals are depleted in ferromagnesian elements and are generally enriched in elements such as silicon, oxygen, potassium and sodium.