Quadrant II – Notes

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Paper Title: **Igneous Petrology**

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Module Name: **Igneous Structures**

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Notes:

Vesicular structures: Volatiles are an important constituent of magmas for: As the magma rises, the pressure is reduced, and the volatile constituents escape from solution in the magma and expand.

Although most of the dissolved volatiles are expelled during pressure release associated with the initial eruption, some remain in the magma.

Any dissolved gases remaining in the lava after the first eruption will leave solution and form bubbles, called vesicles, which rise and concentrate toward the surface of lava flows.

Amygdaloidal structures: Long after solidification of lava flows, vesicles may fill with later minerals deposited by hydrothermal solutions. Such filled vesicles are called amygdules and are common in mafic flows.

Sheet and platy structures: These structures are characterized by fracture and parting. In granites it is common to find three sets of joints, one more or less horizontal, the other two vertical and perpendicular to each other. If these three systems of partings are more or less equally spaced, the fracture planes give rise to a structure of cuboidal resembling a gigantic wall. The horizontal joint planes are sometimes so closely spaced as to produce a sheet structure. The sheets are commonly thinner as the surface of the ground is approached and they usually

show some degree of parallelism to the surface. Rocks are often intersected by very closely-spaced, irregular, joint planes that, on weathering, break into small, sharply-angular fragments from which it is difficult to obtain a hand specimen of the normal size. One-set of closely spaced joint planes may be so well developed as to produce a platy fracture.

Columnar structures: As flood-basalts flows cool, they shrink and develop a characteristic set of fractures which, because they break the rock into regular five- or six-sided columns, are known as columnar joints. Because the stress necessary to fracture the rock is generated by cooling, the fractures propagate perpendicular to the cooling isotherms.

Types of basaltic lava flows: Basically, 3 types of basaltic flows can be recognized. Three are typically subaerial, for which two have names from the native Hawaiian tongue: aa (blocky) and pahoehoe (ropy). The third flow type is subaqueous pillow lava. The main subaerial aa and pahoehoe flows differ in surface morphological characteristics and in the dynamics of emplacement.

Pa Hoe Hoe/Ropy lava: In the early stages of a basaltic eruption, magma emerges as lava at about 1200°C, this lava has a very low viscosity, and runs down slope in rivers with initial velocities as high as 60 km/hr. This runny lava cools and forms a smooth black surface, which may develop a corrugated, or ropy, appearance. Low-viscosity lava can produce pahoehoe flows that consist of thin, glassy sheets, tongues, and lobes, commonly overlapping one another. Restrictions in downslope flow cause the glassy skin of the flow tongue to wrinkle into ropelike festoons. Downslope, lava pressure builds up within the rubbery skin, inflating the sheet or tongue and causing breakouts of a new tongue.

Aa/Blocky lava structures: As the lava cools further, and the viscosity increases, the flows begin to move more slowly, and develop a thicker crust. As the fluid interior continues to move, the crust breaks up into blocks, which ride passively on the top. Pieces also tumble down the advancing front. The motion is like a conveyor belt, in which the surface slides beneath the front of the advancing flow. Thus the blocks are found both at the top and the base of the flow. The rubble-like lava flows that result are called aa.

Pillow structures: Pillow lavas are usually of low-viscosity basaltic magma formed where it comes into contact with water or water-saturated sediment, even in shallow intrusive situations (Walker, 1992). Their most widespread

occurrence is on the seafloor where they have developed by extrusion along spreading ridges and on seamounts. Although having the appearance in most exposures, such as roadcuts, of a pile of discrete, independent ellipsoids of pillow shape and size, usually consist of a tangled mass of elongate, grooved, interconnected flow lobes that are circular or elliptical in cross section.

Flow structures: No lava is ever quite homogeneous during and immediately after extrusion. Layers and patches in it differ slightly in composition, gas-content, viscosity, and degree of crystallization. In the process of flow, these structures are drawn out into parallel lenticles, streaks, bands, and lines which may be characterized by the development in various proportions of vesicles, glass, microlites, crystals and stony material of slightly varying composition manifested by slight differences in colour and texture.