Advanced Igneous Petrology - Mid Ocean Ridge Basalts

The major goals of this lab are:
1) To introduce the accepted terms used to describe textures in basaltic extrusive rocks
2) To explore the relationship between phenocryst assemblages in the aphyric lavas and chemical composition
3) To provide examples of textural characteristics that indicate the operation of open system magmatic processes

1) Petrographic descriptions
Basalts are often classified in terms of the % of phenocrysts present and by the identity of the phenocrysts

Modal % of phenocrysts
aphyric < 1 % phenocrysts
sparsely phyric – 1 to 2 % phenocrysts
moderately phyric – 2 to 10 % phenocrysts
highly phyric > 10 % phenocrysts

   For example: a sparsely phyric plagioclase – olivine basalt contains 1 to 2 % phenocrysts of plagioclase and olivine and most of the phenocrysts are plagioclase. When phenocrysts are present, they should also be described if they are distinctively clustered as glomerocrystic with the types of phenocrysts that are present. Also, the size of the phenocrysts and the presence or absence of melt inclusions should be noted.

   The texture of the groundmass is also useful in communicating the characteristics of a rock. These textures are found in Williams, Turner and Gilbert (Petrography, 2nd edition) p. 59 – 67. The presence or absence of vesicles and the nature of any alteration products should be noted.

   A) Choose 2 of the following samples that show the biggest variation in texture and provide succinct petrographic descriptions. Include the information outlined above. For an example of concise textural description, check out the thin section descriptions of units defined by the Shipboard petrologists in the Proceeding of the Ocean Drilling Program – Initial Reports (see p. 98 – 99 of Leg 106/109).

| 129 | 648B-6R01-061-064 | 648B-18R01-032-034 | ALV-525-4b |
| 130 | 648B-15R01-086-088 | ALV-528-1-1 | ALV-824-3 |

   B) The composition of the glasses for 2 of these samples is given below. Is one of these compositions close to being a primary melt? What is the petrographic and compositional evidence that leads you to this conclusion?

	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MgO	MnO	CaO	K_2O	Na_2O
528-1-1	48.8	.84	16.2	-	9.0	9.76	.16	12.4	.09	2.35
648B	50.1	1.60	16.3	-	9.43	7.88	.17	11.3	.13	2.96

2) Phenocryst assemblage and bulk chemical composition.

        A. The most basic recalculation of a rock chemical analysis is to recast it into the norm or "normative constituents". Select one analysis (either 528, 648B, 77-23 or 77-28) and calculate the CIPW norm. Then classify the lava using the Yoder and Tilley (1962) classification scheme.

        B. For sample AII-77-23-1, recalculate the oxide wt. % analysis into oxygen-based mineral components using the scheme of Tormey et al. (1987). The Grove reprint describes the method. Next, use the technique of Grove et al (1992) or Huang et al. (1996) to calculate the OPAM saturation boundaries relevant for this composition. Plot these boundaries on the Oliv – Cpx – Qtz and Oliv – Plag – Cpx projections schemes along with the projected composition of AII-77-23-1. What can you say about the pre-eruption history of this sample? Describe the thin section of AII-77-23-1 as you did for the samples in task 1. What are the phenocryst phases? Does the phenocryst assemblage support your conclusions drawn from the projected composition of AII-77-23-1?

        Repeat exercise B for AII-77-28-2

	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MgO	MnO	CaO	K_2O	Na_2O	sum
77-23-1	52.4	1.77	13.8	.04	11.4	6.76	.16	10.6	.20	2.35	99.48
77-28	52.3	1.16	13.9	.03	9.90	7.83	.18	11.6	.11	2.03	99.04

3) Textural evidence of open system behavior

ALV-530-2-1,
AII-77-67-6,
131
137

For any two of these samples determine the phenocryst assemblages and describe the textural and compositional characteristics (to the extent possible) of phenocryst assemblages. What can you say about the pre-eruptive history of the lava? Choose phenocrysts that you would like to image and analyze in the electron microprobe. Then, let's look at them in the microprobe!