

No explicit account is taken of variations in temperature and pressure. At high pressures r_i decreases, commonly decreasing more for large ions. One would expect that differences between ions would be suppressed at elevated pressures, and that immiscibility would therefore tend to be suppressed. At high temperatures, the effects are reversed, the ionic radii expanding somewhat with temperature. All of these adjustments however are so small relative to the possible errors in the basic assumptions that it is not worthwhile to amend the model to attempt to take account of variations in pressure and temperature. As an empirical observation, immiscibility seems most common in silicate melts at low pressures (volcanic conditions), and temperatures at which abundant crystallization is occurring.

In order to test the model, the free energy of melts in the system fayalite-leucite-silica and related systems have been calculated (Table 1). The model correctly predicts the appearance of immiscibility in the system fayalite-kalsilite-silica, as discovered by Roedder⁷, and correctly denies the possibility of immiscibility in other related systems. Comparison of the calculations in the fayalite-kalsilite-silica system suggest that the criterion is somewhat conservative, since the calculated immiscibility field is smaller than that mapped by Roedder. The ionic radii utilized (from the *Handbook of Chemistry and Physics*, 47th ed., 1966, p. 3) may explain part of the difference.

The success of the model in this simplified experimental system suggests its application to more complex natural systems. When applied to the ocellar lamprophyre dikes at Callander Bay, Ontario, for which observational and experimental evidence of immiscibility have been presented², the formula predicts a large free energy advantage for splitting the homogeneous composition into immiscible fractions (Table 2). Indeed the advantage is the largest found thus far for any natural rock. Even here, experimental evidence suggests that immiscibility is suppressed by application of 3-4 kbar pressure².

The second group of data in Table 2 demonstrate a more speculative use of the criterion. Mont St Hilaire, roughly 20 miles east of Montreal, Quebec, is a circular pluton about 2 mile in diameter consisting of roughly 50% mildly alkaline gabbro, intruded by agpaite syenite. Chemical analyses do not suggest any reasonable mechanism of normal differentiation which can produce either the compositions or the relative proportions of the two halves of the intrusion. Calculation of the relative free energies of the agpaite syenite and of the latest differentiate on the gabbroic side of the mountain (nepheline diorite), suggests that they would form immiscible

Table 1 Calculated Gibbs Free Energy of Experimental

Fe ₂ SiO ₄ -SiO ₂		KAlSi ₂ O ₆ -Mg ₂ SiO ₄ -SiO ₂			NaAl
(1)	(2)	Homo	(1)	(2)	Homo
40.21	36.21	38.21	40.21	36.21	38.21
3.70	7.70	5.70	3.70	7.70	5.70
12.20	12.20				12.20
		12.20	12.20	12.20	
					5.70
3.70	7.70	5.70	3.70	7.70	
3.48	991.27	812.42	711.07	909.65	703.0
		812.42			703.0
842.37			810.36		

s per 100 oxygens. The composition in the field leucite and is compared with analogous compositions in related