**Appendix 3**

**Fractional crystallisation modelling**

Fractional crystallisation trends can be obtained by mathematically extracting mineral phases that are believed to have fractionated during the evolution of magmas. These trends are well-constrained when the composition of the minerals for a particular magma is known. In this work, fractional crystallisation modelling involved clinopyroxene (Mg-rich augite and titanian diopside), olivine and plagioclase minerals with compositions obtained both in Camp et al. (1987) and Murcia et al. (under review) (Table A3). The modelling started from the rock with the highest MgO content of the *1256 AD* (Mg# = 63 / MgO 9.3 wt.%; sample HM-24-2; Murcia et al., under review) and *Al-Anahi* (Mg# = 51 / 6.0 wt.%; sample HM-256-1; Appendix 1) volcanic centres, respectively. So, the following equation applies:



Where

is the concentration (wt.%) of major element in the rock after fractionation,

 is the current concentration (wt.%) of major element in the rock,

is the current concentration (wt.%) of major element in the mineral,

*F* is the % of fractionation

**Table A3.** Chemical composition of the mineral assemblages used for fractional crystallisation modelling in northern Harrat Rahat. Clinopyroxene compositions (Endiopside = Mg-rich Augite, Titansalite = Titanian diopside; cf. Morimoto, 1988) are reported as average in Camp et al. (1987) for the *1256 AD* eruption products. Olivine and plagioclase concentrations were reported in Murcia et al. (under review) and correspond to equilibrated minerals in one of the rocks with the highest MgO content (Mg# = 61 / MgO 8.6 wt.%; sample HM-24-1).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Major element** | **Mineral** | | | |
| **Olivine** | **Clinopyroxene** | | **Plagioclase** |
|  |  | **Mg-rich Augite**  (Endiopside) | **Titanian diopside**  (Titansalite) |  |
| **SiO2** | 39.74 | 49.70 | 45.53 | 48.86 |
| **TiO2** |  | 0.53 | 4.07 | 0.19 |
| **Al2O3** |  | 6.67 | 5.24 | 33.34 |
| **FeO** | 13.61 | 4.99 | 11.55 | 0.54 |
| **MnO** | 0.18 |  |  |  |
| **MgO** | 44.92 | 15.97 | 10.84 |  |
| **CaO** | 0.3 | 19.76 | 21.22 | 15.41 |
| **Na2O** |  |  |  | 2.45 |
| **K2O** |  |  |  | 0.15 |
| **P2O5** |  |  |  |  |
| **Cr2O3** |  | 1.14 | 0.05 |  |
| **TOTAL** | 98.75 | 98.76 | 98.50 | 100.53 |

**References**

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