Metals and chlorine in the evolution of convergent margin magmas

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We have investigated the behaviors of Cu, Au, Re and Cl in subduction-related volcanic glasses belong to basalt-andesite-dacite-rhyolite fractionation series from the eastern Manus backarc basin. At the early stage of magma evolution, Cu, Au and Re increase with increasing SiO_2 content. Copper and Au drop suddenly at SiO_2 content of ~58 wt%, concurrent with a switch in the behavior of titanium and iron from concentration increases to decreases as SiO_2 rises [1]. This relates to the crystallization of titanomagnetite, which reduces sulphate to sulphide, forming Au-Cu hydrosulphide complexes, and thus Au and Cu are taken into comagmatic fluids. This can plausibly explain the genetic links between Au-Cu ore deposits and convergent margin magmas. By contrast, Re starts to drop at SiO_2 content of ~60 wt% and, shows continuous decrease [2]. The solubility of Re in magmas increases with increasing oxygen fugacity [3], therefore the observed Re behavior is controlled by oxygen fugacity bufferring during titanomagnetite crystallization. Chlorine is highly incompatible during the whole evolution of the eastern Manus basin magmas. Modelling shows that the behavior of Cl in magmas is strongly influenced by pressure, initial H_2O content, and the degree of magmatic fractionation. For basaltic magmas with low initial H_2O contents (< 2.5 wt%), Cl is highly incompatible under essentially all pressures. For more evolved magmas at moderately high pressure and high H_2O contents, considerable amounts of Cl can be extracted from the magma once H_2O saturation is reached. Accordingly, Cl is usually highly incompatible in MORB and OIB, because of low H_2O contents and relatively low degrees of fractional crystallization. The behavior of Cl in arc magmas is more complicated, ranging from highly incompatible to compatible depending on H_2O contents and depths of magma chambers. It also behaves differently in intrusive rocks compared to volcanic rocks because of the different pressures involved.

References

[1] Sun W.D., Arculus R.J., Kamenetsky V.S. and Binns R.A., (2004) *Nature* **431**, 975-978.

[2] Sun W.D., Arculus R.J., Bennett V.C., Eggins S.M. and Binns R.A., (2003) *Geology* **31**, 845-848.

[3] W. Ertel, H.S. O'Neill, P.J. Sylvester, D.B. Dingwell and B. Spettel, (2001) *GCA* **65**, 2161-2170.