

Apatite composition of Southern Germany volcanoes: Clues to origin and magmatic evolution

A. VON DER HANDT¹ AND M.K. RAHN²

¹Geowissenschaftliches Institut, University of Freiburg 79104 Freiburg, Germany

²Swiss Federal Nuclear Safety Inspectorate (ENSI), 5200 Brugg, Switzerland

Volcanic activity in SW Germany has focussed along the Upper Rhine graben (with volcanic centres at Kaiserstuhl and Odin's Forest). In addition, eruptive centres are also found far away from known tectonic lines in the Urach and Hegau areas. Dating of these rocks reveals an extended period of activity along the Upper Rhine graben (60-15 Ma [1]), while activity in isolated centres was relatively short (Kaiserstuhl: 16-19 Ma [1, 2], Hegau: 15-7 Ma [3, 4], Urach: 17-? Ma [5]).

Apatite is a common mineral in many of the eruptive products, which are mostly of mafic to ultramafic as well as carbonatitic composition. Previous studies on these apatites (e.g. Rahn and Selbekk 2008) have shown that their composition is variable with respect to Si and S (replacing P) as well as OH and Cl (replacing F). Thus the question arises whether apatite could be used as an indicator of magmatic evolution and whether there are clear differences to be found, which allow a distinction between the Kaiserstuhl, Hegau and Urach eruptive centres on the basis of apatite composition.

In order to evaluate the compositional evolution, apatites from the Kaiserstuhl and Hegau were dated using the fission track technique. Dated samples were analysed by means of EPMA and SIMS to obtain major and trace element data and check for sample internal variation. Both, Kaiserstuhl and Hegau volcanics show a large compositional range from F-rich to OH-rich chemistry, with Cl-endmember lower than 5%. Apatites close to OH endmember are restricted to samples from the Hegau. A clear distinction of sources is possible on the basis of Sr, Zr and REE element contents. Hegau apatites show a wider spread in magmatic REE fractionation, together with flatter chondrite REE patterns. Combination of age and compositional data allows to clearly attribute distant tuff layers to the Hegau, while no such layers show Kaiserstuhl characteristics. Erupted material from the Hegau has faced up to 80 km of westward air transportation.

[1] Keller *et al.* (2002) *SMPM* **82**, 121–130. [2] Kraml *et al.* (2006) *Geostand. Geoanal. Res.* **30**, 73–86. [3] Schreiner (1992) *Geol. Landesamt BW*, 290p. [4] Rahn & Selbekk (2008) *Swiss J. Geosc.* **100**, 371–381. [5] Kröcher *et al.* (2009) *Zeitschr. deut. Ges. Geowissensch.* **160**, 325–331.

Chemical speciation of Fe-rich colloids and nanoparticles in the Southern Ocean

B.P. VON DER HEYDEN^{1*}, A.N. ROYCHOUDHURY¹ AND S.C.B. MYNENI²

¹Dept. of Earth Sciences, Stellenbosch University, Stellenbosch 7602, South Africa

(*correspondence: bvon@sun.ac.za)

²Dept. of Geosciences, Princeton University, Princeton, NJ 08544, USA

Iron is an important nutrient and limits the productivity in the Southern Ocean. Previous biogeochemical studies largely focused on the size-dependent Fe-pools in ocean water with little attention to the chemical speciation of iron. As a result, molecular level factors affecting the bioavailability of particle-bound iron are largely unexplained.

Using clean techniques, samples were collected along two transects between Cape Town, Antarctica and the South Georgia Islands. Iron particles were trapped on 0.2µm filters and subsequently analyzed in their pristine state using *in situ* L-edge XANES spectroscopy and high-resolution scanning transmission X-ray microscopy. Chemical speciation of the discreet, quasi-spherical particles was accomplished through a combination of the spectral shape analysis and the quantitative parameterization of the L₃-edge splitting.

From these spectroscopic analyses, particles in Southern Ocean could be classified into five broad categories including ferric oxides, magnetite, other mixed valence species and at least two ferrous species. A distinct spatial variation in iron speciation was also evident with ferric species predominating in the mid-latitudes (32°S- 55°S) and ferrous-rich species more common in the high latitudes. A number of mixed-valence species, including magnetite, made up a significant proportion of the particles found to the north of the Polar Front. Proximal to the African- and South Georgian shelves, Al-substitution, a solubility-depressing effect, was observed to occur in the ferric species. The substituted Al in iron oxides displayed a gibbsite-like structure.

We are currently evaluating the cause of this spatial and chemical variability, which may be attributed to the particle source, and to a range of processes including photochemical response and biological interactions. However, it is clear that such variability in speciation will have a profound impact on Fe solubility and iron-ligand interaction, thereby influencing the Fe-pool that is bioavailable.