Fluorine and Chlorine in the transition Zone

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Abstract

We report concentrations of Fluorine (F) and Chlorine (Cl) in synthetic wadsleyite (Wd) and ringwoodite (Rw). Synthesis were performed under pressures (14–22GPa) and temperatures (1100–1400C) relevant to the transition zone (TZ: 410–670 km depth) using multi-anvil press experiments in MLV Clermont-Ferrand, France and in BGI Bayreuth, Germany. F, Cl and H contents were measured using Particle Induced Gamma-Ray Emission (PIGE), Particle Induced X-ray Emission (PIXE) and Elastic Recoil Detection Analysis (ERDA) respectively, using a nuclear microprobe at CEA Saclay. Results show that F (up to 850 ppm wt.) and Cl (up to 200 ppm wt.) are concentrated together with H2O in both Wd and Rw (Roberge et al., 2015; 2017). Cl content in Rw and Wd is significantly higher than in other nominally anhydrous minerals of the upper mantle (olivine, pyroxene, garnet), when we found that F is also concentrated in hydrous olivine (up to 1700 ppm wt., Crepisson et al, 2014). With these data we put constraints on the F and Cl budget of the deep Earth, we propose that the TZ may be a major repository for major halogen elements in the mantle. We also show that both F and Cl abundances are underestimated for the bulk silicate Earth (BSE). We propose maximum abundances for the BSE of 59 ppm wt. F and 37 ppm wt. Cl, these abundances are higher than the values proposed by McDonougth and Sun in 1995, of 25 and 17 ppm wt. respectively. New results on F-bearing ringwoodite will be presented at the meeting.

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