

The application of granular activated carbon on remediation in trichloroethylene contaminated groundwater

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The objective of this study is to evaluate the effect of ionic strength and hardness of trichloroethylene (TCE) contaminated groundwater on remediation using granular activated carbon (GAC). The sorption rate of TCE by GAC was observed by batch experiments. The sorption kinetic of GAC was analyzed by kinetic models. As the ionic strength and hardness of the synthetic groundwater increased, the TCE sorption rates of GAC in the synthetic groundwater decreased. The TCE sorption rates of GAC in synthetic groundwater were 100%, 93.0%, 90.2%, and 86.2%, respectively. These results showed that the TCE sorption rates were affected by the relationship between the ionic strength and the hardness of the synthetic groundwater. The Elovich model ($r^2=0.99$) is more precise than Pseudo first order model ($r^2=0.96$). This indicates that the Elovich model is well represented in the contaminated groundwaters which have various factors like ionic strength and hardness. The surface area of the GAC was 958.98 m²/g and the calculated sorption areas of TCE & ions were 318.38 m²/g, which were 32.2% of the GAC surface area. Therefore, the ionic strength and hardness of groundwaters must be considered in the remediation of TCE-contaminated groundwater using GAC.

Accessory phase control on the trace element signature of subduction zone fluids

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In order to understand the general trace element signature of arc lavas, phase and melting relations in metapelites at sub-arc depth are of first order importance. Here we present results from experimental studies on a trace element doped, hydrous (2-7 wt.% H₂O), synthetic pelite and granite in the range 20-45 kbar and 600-1050°C, i.e. conditions relevant for the slab at sub-arc depth. In the metapelite, a hydrous melt that quenches to a glass is present at conditions above 700°C, 25 kbar; 750°C, 35 kbar and 800°C, 45 kbar. At lower temperatures, a solute-rich aqueous fluid is present that is not quenchable. This fluid has been captured in diamond traps in the experiments and the quench material as well as the glass have been analysed with LA-ICP-MS.

One surprising feature in the run products is the presence of accessory phases at subsolidus as well as at suprasolidus conditions, even at large melt proportions of 50%. Rutile, apatite and zircon have been found over the entire investigated P-T range. Allanite is present at 2.5 GPa up to 800°C, and at 3.5 and 4.5 up to 750°C. At higher temperatures, monazite is stable up to 1000°C. This has profound bearings on the trace element characteristics of the fluid phase. In a residue consisting of garnet, clinopyroxene, phengite and coesite all trace elements in the fluid phase are governed by partitioning behaviour. In contrast, in the presence of accessory phases, several trace elements are buffered (Ti by rutile, P by apatite, Zr by zircon, LREE by monazite/allanite). Additionally, other HFSE and REE are preferentially retained in the residue with respect to a system without these accessory minerals. This is documented in the measured composition of the fluid phases. For example LREE display only incompatible behaviour at the highest temperature investigated (950-1000°C) whereas at 800°C, LREE are compatible in the residue due to the presence of monazite or allanite. In the aqueous fluid LREE are about an order of magnitude lower than in the hydrous melt at 750°C. Zircon is able to fractionate geochemical twins such as Zr and Hf. Hf decrease in the melt is less pronounced than Zr decrease with decreasing temperature and thus hydrous melts at 750-800°C leaving the slab have a Zr/Hf significantly lower than the primitive mantle value. Aqueous fluids are very dilute in all trace elements and even LILE are higher in the residue than in the fluid. For example Ba is more than 10 times lower in the aqueous fluid than in the residue. This provides evidence that hydrous melts and not aqueous fluids are needed to significantly recycle incompatible elements from the slab to the mantle wedge. This observation provides evidence that top slab temperatures $\geq 750^\circ\text{C}$ are required below arcs that show significant LILE and LREE enrichment or a Hf contribution from sediments.