^{238}U and ^{235}U isotope fractionation under water – U-bearing rock interaction

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We present results on $^{238}U/^{235}U$ and 234U/238U for U-mineralized rocks and ground waters. Both ratios were analysed by MC-ICP MS. $^{238}U/^{235}U$ was precisely (± 0.07‰) analysed with ^{233}U–^{236}U double spike.

We studied rocks and waters from open-pit of Tulukuevsky U deposit of 135 ± 2 Ma age (Streltsovsky ore field, E. Tranbaikalia). Walls of the open-pit expose rhyolitic ignimbrites containing off-balance fine-disseminated mineralization. Host ignimbrites have $^{238}U/^{235}U$ in a range 137.870 – 137.802. Ground waters drained by the deposit open-pit are ~ 0.14‰ lighter in $^{238}U/^{235}U$ (137.814 – 138.791). The last have positive correlation with $^{234}U/^{238}U$ ($\times 10^5$) ratio, which lies in range 9.65 – 7.37 much higher than equilibrium value. Acid leachates (2N HCl) from the ignimbrites exhibit lower $^{238}U/^{235}U$ values (137.841 – 137.715) as compared to whole rock samples.

Our findings imply that water-rock interaction results in 235U enrichment in liquid. It is consistent with the results obtained for conditions, such as HCl-leaching of euxenite [1], HF-abrasion of zircons [2]. T^0-dependent isotope fractionation during redox U(VI) → U(IV) [3, 4] could be responsible for wide range of $^{238}U/^{235}U$ variations (0.12 – 0.70‰), which we have found inside individual U deposits. It includes variations (up to 0.45‰) documented in local volumes of U-oxide aggregates [5]. Thus ^{238}U and ^{235}U isotope fractionation, which is caused by natural water action and experimental acid leaching of U-bearing minerals, is due to dissolution of minerals possessing originally divergent $^{238}U/^{235}U$.

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[1] Stirling *et al* (2007) *EPSL*, **264**, 208-225 [2] Hiess *et al* (2012) *Science* **335**, 1610-1614 [3] Weyer *et al* (2008) *Geochim. Cosmochim. Acta*, **72**, 345-359 [4] Schauble *et al* (2009) *Elements*, **5**, 369-374 [5] Chernyshev *et al* (2013) *Goldschmidt 2013*. Conf. Abst., 871