

Changes of detrital zircon composition through time: deductions from a large database

C.M. ALLEN, I.H. CAMPBELL AND T. IIZUKA

Research School of Earth Sciences, Australian National University, Canberra Australia 0200

We have analyzed zircons separated from sand samples collected from 40 of the world's major rivers draining all of the continents except Australia and Antarctica. Using an Agilent 7500s ICP-MS coupled to an excimer laser through an in-house built sample cell we have concomitantly measured zircon U-Th-Pb ages, plus Si, Zr, Hf, P, Ti, Y, La, Ce, Eu, Sm or Nd, and Lu in a 60 second analysis. All are substantially above detection limits except Ti (~3 ppm) and La (~1 ppm) in some zircons. In 6650 zircon analyses as old as 3500 Ma, we have 5353 concordant age results with the trace element suite. Ti and Y were added more recently (n~2300).

Exactly what the age and trace element age spectrum from a river sand represents can be debated. What zircon has been lost through geological processes over Earth history is not quantified. But what if all the world's rivers were sampled, zircons analysed and compiled? 2700 Ma to today, Hf is the only element to have decreased in abundance, the average declining from 1.30 to 1.23 wt%. U, Sm, Nd and Lu all have increased. For instance Lu has increased from 43 to 71 ppm from 2700 Ma to today. P has also increased but in a stepwise fashion, averaging 305 ppm before 650 Ma, and 390 ppm since. Averages of Ti, Y, U/Th and Ce anomaly have not changed over this time span beyond uncertainty. In contrast, Eu anomaly has a restricted range of values from 0.1 to 1 before the zircon production quiet period of 2400-2100 Ma, and a wider range (0.01 to 1) since. Average Lu/Hf of zircon has increased substantially from about 0.0035 at 2700 Ma to 0.0058 today mostly due to the increase in Lu.

Sulfur exchange between seawater and oceanic basement

JEFFREY C. ALT¹ AND WAYNE C. SHANKS²

¹Dept. Geological Sciences, The University of Michigan, Ann Arbor, MI 48109-1063, USA (jalt@umich.edu)

²U.S. Geological Survey, Denver Federal Center, MS 973, Denver, CO 80225, USA (pshanks@usgs.gov)

We examine the geochemistry of sulfur in a 1.25 km section of ocean basement at IODP Site 1256, formed at the fast-spreading East Pacific Rise 15 m. y. ago, in order to understand exchange between seawater and ocean lithosphere at varying spreading rates.

Basalts from the 800 m volcanic section have lost variable amounts of sulfur through oxidation by seawater, but sulfide-S was added to the rocks locally through formation of secondary pyrite in alteration halos and veins. The low alteration temperatures (<~100°C), plus bulk rock and vein pyrite $\delta^{34}\text{S}$ values of +2 to -28.6‰ indicate addition of sulfur via microbial reduction of seawater sulfate. Mass balance yields a bulk S content of 770 ppm for the volcanic section, only slightly lower than the original degassed bulk S content of ~900 ppm. This is attributed to the smooth basement topography at fast spreading rates being easily sealed by sediment, restricting seawater access and limiting oxidation compared to rougher basement at intermediate and slow spreading rates.

Hydrothermal fluids upwelling through the dikes produced minor sulfide mineralization in the upper dikes, resulting in a bulk S content of 3800 ppm in the 50 m lavas-dikes transition zone. The underlying 300 m dike section and 100 m plutonic section have bulk S contents of 1250 and 1190 ppm, respectively. The weighted average S content of the entire 1250 m basement section is 1060 ppm, a slight increase from estimated original (degassed) S content of 900 ppm, reflecting fixation of seawater sulfur in the basement. The S content of Hole 1256D basement is higher than that at intermediate spreading rate, reflecting more reducing conditions in the lavas and greater effects of evolved hydrothermal fluids in the intrusive portion of the fast-spreading crustal section. Refining estimates of sulfur exchange between ocean lithosphere and the world ocean requires detailed understanding of hydrothermal processes in basement sections from different areas, formed at the full range of spreading rates.