Rapid deep-water renewal in Lake Issyk-Kul (Kyrgyzstan) indicated by transient tracers

Hofer, Markus, Frank Peeters, Werner Aeschbach-Hertig, Matthias Brennwald, Johannes Holocher, David M. Livingstone, Vladimir Romanovski, Rolf Kipfer

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ABSTRACT: Simultaneous profiles of the transient tracers sulfur hexafluoride (SF_6), ^3H-^3He, and the chlorofluorocarbons CFC-11 and CFC-12 were measured in Lake Issyk-Kul, a large, deep lake in Kyrgyzstan. Apparent water ages derived from these measurements suggest rapid mixing, with a deepwater renewal rate >10% yr^{-1} at 650 m depth. SF_6 and 3H-3He ages agree reasonably well, whereas CFC ages are significantly greater. The discrepancy is explained by the nonlinear relationship between tracer age and tracer concentration and by the flattening of the atmospheric growth curves for CFCs. Novel to physical limnology is the application of SF_6 dating, which proves to be an excellent tool for the study of mixing in lakes, complementing ^3H-^3He and CFC dating techniques.