



Lessons from a proficiency assessment of 235 laboratories conducting isotope analyses of water by isotope-ratio and laser-absorption spectrometers

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The stable isotope composition of water (d_2H , $d_{18}O$) is a crucial tracer of hydrological processes, hence accurate assays are required to yield sound scientific information. We tested the performance of 235 worldwide laboratories conducting isotope analyses of water by IRMS and laser spectrometers. Eight samples comprised the d-range of natural waters including a highly depleted, enriched, saline, and methanol contaminated sample to assess contamination effects. Results showed 73 % of laboratories gave acceptable results, but 27 % produced unacceptable results. Methanol contamination resulted in extreme outliers for laser spectrometers, but also affected reactor-based IRMS systems. Analysis of results and metadata suggested poor performance stemmed mainly from skill and knowledge-based errors including: calculation mistakes, compromised calibration standards, faulty instrumentation, lack of vigilance to contamination, and inattention to unreasonable isotopic outcomes. To counteract these, we recommend laboratories include 1-2 isotopically known controls in all runs; laser spectrometry laboratories should screen for spectral contamination, and all should evaluate if derived d-excess values are realistic if both isotopes are measured. Together, these strategies should immediately inform the laboratory about fundamental mistakes or compromised samples.