United States Department of the Interior

U. S. GEOLOGICAL SURVEY
Water Resource Discipline
National Center M.S. 431
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Dear Dr. Abdullayev:

The Reston Stable Isotope Laboratory has analyzed the following sample received from you for isotopic analysis.

We analyzed your sample labeled drinking water both for stable hydrogen and oxygen isotopic composition. The measurement results of the individual analyses and the means are listed in Tables 1 and 2.

Methods

Since May 1, 1990, hydrogen-isotope-ratio analyses have been performed using a hydrogen equilibration technique (Coplen and others, 1991; Revesz and Coplen, 2008a), rather than the zinc technique used prior to that date (Kendall and Coplen, 1985). In addition, we analyzed your sample using a Los Gatos Research isotope water analyzer. These laser absorption results (prefix B) agree well with the equilibration analyses (prefix V) above.

The hydrogen equilibration technique measures deuterium activity, whereas the zinc technique measures deuterium concentration. For the majority of WRD samples, the difference in reported isotopic compositions between the two techniques is not significant. However, in brines, the difference may be significant (Sofer and Gat, 1972, 1975). Reported δ^2H values of activity are more positive than δ^2H values of concentration, and this difference is proportional to molalities of the major dissolved solids. Some examples of the differences between activity ratios and concentration ratios for δ^2H in 1 molal salt solutions are as follows (Horita and others, 1993). The data for individual salts may be multiplied by molality to obtain adjustments to delta values based on concentration.

Solution (1 molal)	δ^2H (activity) – δ^2H (conc.) (30 °C)
NaCl	+2.07 ‰
KCl	+2.42 ‰
$CaCl_2$	+5.31 ‰
$MgSO_4$	+1.12 ‰

Water samples are measured for delta O-18 using the CO_2 equilibration technique of Epstein and Mayeda (1953), which has been automated (Revesz and Coplen, 2008b). Therefore, both oxygen and hydrogen isotopic ratio measurements are reported as activities.

Reporting of Stable Hydrogen and Oxygen Isotope Ratios
Oxygen and hydrogen isotopic results are reported in per mil relative to VSMOW (Vienna Standard Mean Ocean Water) and normalized (Coplen, 1994) on scales such that the stable oxygen and hydrogen isotopic values of SLAP (Standard Light Antarctic Precipitation) are –55.5 ‰ and –428 ‰, respectively. I would not be surprised if the "true" mean values were off by 2 or 3 ‰ or so. Without a lot of work, this would be difficult for us to quantity.

Table 1. Hydrogen isotopic results

Analysis Number	$\delta^{18}O_{VSMOW-SLAP}$
B-39587	–985.38 ‰
B-39588	–985.48 ‰
V-334073	–985.97 ‰
V-334178	–989.05 ‰
V-334179	–986.39 ‰
V-334181	–987.69 ‰
V-334182	–987.83 ‰
V-334183	–990.44 ‰
V-334184	–988.62 ‰
V-334185	–986.54 ‰
V-334186	–987.64 ‰
V-334187	–986.96 ‰
V-334189	–989.05 ‰
V-334190	–987.09 ‰
Mean	**–987.4 ± 1.5 ‰**

Table 2. Oxygen isotopic results

Analysis Number	$\delta^{18}O_{VSMOW-SLAP}$
B-39517	–720.48 ‰
B-39587	–724.29 ‰
B-39588	–724.08 ‰
D-254881	–721.72 ‰
Mean	**–722.6 ± 1.9 ‰**

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Sincerely,

Tyler B Coplen
Director, Reston Stable Isotope Laboratory