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14 March 1967


## Deuterium and Oxygen-18 in Natural Waters: Analyses Compared

The International Atomic Energy Agency recently compared mass-spectrometric analyses of isotope ratios of deuterium and oxygen-18 in natural water. One aim was to enable laboratories the world over to compare published results that may refer to the same scale but may in fact differ because of systematic analytical errors or unreliable standards.

Table 1 summarizes the results from 12 laboratories (*1*) before mid-February 1967. The long-term reproducibility resulted from measurements of the same sample over a period of at least a few months. Agency (IAEA) sample 1 represents ground water, sample 2 is a mixture of two surface samples collected from the Kattegat and the Baltic Sea, and sample 3 is surface water from Greenland. Sample 2 contained 35.3 percent Cl, and 0.002 percent $HgCl_2$ was added against bacterial activity. Duplicate 20-ml samples were sent to participating laboratories in sealed glass ampoules along with samples of NBS-1 and NBS-1A, obtained in plastic containers from the National Bureau of Standards. The data relating to the NBS standards are not included, since it became obvious that the plastic containers were not suitable and that variations due to evaporation and exchange were prominent. The data presented are based on comparison with working standards (previously calibrated against a primary standard such as NBS-1 and NBS-1A) or, in a few instances, on absolute measurements.

Table 1. Analyses of $^{18}O$ and deuterium in three samples of water; permillage deviations from SMOW (*2*) (deviation, $1\sigma$).

| Laboratory | IAEA sample 1 | IAEA sample 2 | IAEA sample 3 | Long-term $\sigma$ (‰) |
|---|---|---|---|---|
| | | *Oxygen-18* | | |
| 1 | −8.88 ± 0.04 | +0.58 ± 0.03* | −29.36 ± 0.05 | 0.07 |
| 2 | −10.84 ± .4 | −1.51 ± .4 | −30.58 ± .4 | |
| 3 | −9.02 ± .11 | +0.19 ± .10 | −29.39 ± .14 | |
| 5 | −8.71 ± .08 | + .20 ± .09 | −29.33 ± .29 | |
| 6 | −9.09 ± .08 | + .33 ± .08 | −29.42 ± .13 | |
| 7 | −8.99 ± .03 | + .49 ± .04 | −29.40 ± .06 | |
| 8 | −8.93 ± .02 | + .35 ± .02 | −29.11 ± .03 | .07 |
| 9 | −9.12 | + .31* | −29.26 | |
| 11 | −9.17 ± .04 | + .20 ± .04* | −29.17 ± .04 | .05 |
| 12 | −8.95 ± .04 | + .29 ± .01 | −29.34 ± .01 | |
| | | *Deuterium* | | |
| 1 | −61.7 ± 0.5 | +2.3 ± 0.4 | −220.6 ± 0.5 | 1.5 |
| 2 | −62.5 ± 1.0 | −2.5 ± 1.0* | −215.2 ± 1.0 | 1.0 |
| 4 | −62.2 ± 1.1 | +2.3 ± 1.4 | −220.3 ± 1.3 | |
| 5 | −61.3 ± 1.0 | −1.5 ± 1.0 | | |
| 6 | −62.1 ± 0.9 | +0.7 ± 0.7 | −221.7 ± 1.1 | |
| 7 | −60.6 ± .5 | +3.6 ± .4 | −221.8 ± 0.3 | 0.28 |
| 10 | −62.8 ± 1.4 | +2.6 ± .7 | −221.7 ± 1.0 | |
| 11 | −65.7 ± 0.6 | +1.8 ± .6* | −235.5 ± 0.6 | .6 |
| 12 | −62.41 ± .12 | +2.06 ± .06 | −222.6 ± .15 | |

* Sample not distilled.

The Agency is now following the recommendation for establishment of the new standards. Furthermore, a qualified laboratory will try to establish the absolute isotopic concentrations of the new standards. As soon as they are available, samples of the new standards, together with NBS samples, will be distributed among interested laboratories for intercomparison. The Agency thanks cooperating scientists for their collaboration and permission to publish the results.


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13 March 1967