An automatic mass spectrometric system for determining noble gas concentrations in large and small water samples

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System description

A fully automatic gas extraction and purification system for water samples has been developed for mass spectrometric measurement of dissolved noble gases. The system consists of a gas extraction part including a zeolite trap for water vapour trapping, a permanent gas trap held at 25 K for collecting the heavier gases and a cold (10–90 K) charcoal trap for adsorbing and separating the helium and neon fraction of the sample. Argon, krypton and xenon are not separated, but a small split is purified by getter pumps [1]. The different noble gas fractions are admitted to a GV 5400 noble gas mass spectrometer sequentially. The whole measurement process is calibrated using air aliquots which have been prepared in the same way like a sample. In addition, before the mass spectrometric measurement of each fraction, a pure noble gas reference sample, the so called Fast Calibration is measured. In this way, the variation in the sensitivity of the mass spectrometer is taken into account. The process including the sample preparation as well as the mass spectrometric measurement is conrolled by a self-developed Labview-based software.

To interpret the dissolved noble gases in water as noble gas temperature and excess air component with low error it is necessary to achieve a very accurate measurement of noble gases. The achieved precision of each noble gas measurement is around 1 % or less.

Innovative applications

Besides noble gas temperature investigations and T-^{3}He dating of young groundwaters, the formation of excess air in the quasi-saturated zone is being studied. Laboratory and field experiments have been started in order to investigate the mechanisms which are responsible for the excess air formation. Furthermore, the very precise and sensitive noble gas measurements are used to investigate the potential of fluid inclusions in stalagmites and other carbonate deposits from caves as palaeoclimate archives.

References

[1] Beyerle U., Aeschbach-Hertig W., Imboden D.M., Baur H., Graf T., Kipfer R.A. (2000) *Environmental Science Technology* **34**(10) 2042-2050.