Meteoric Cl-36 in recent precipitation in Tsukuba, central Japan

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Meteoric ^{36}Cl mainly originates from the spallation reaction of ^{40}Ar in the stratosphere. After about two years, stratospheric ^{36}Cl enters the troposphere and is washed out by precipitation within a mean residence time of one week. The knowledge of the recent background ^{36}Cl flux is required in order to apply ^{36}Cl as a hydrological tracer. For this purpose, monthly bulk precipitation samples have been collected since April 2004 at the roof of the Natural Sciences Building, University of Tsukuba. After filtration through a 0.45 micron membrane, the samples were passed through anion-exchange columns to concentrate chloride ions in the solutions. The ^{36}Cl/Cl ratios were measured by accelerator mass spectrometry (AMS) at the University of Tsukuba.

The results showed a clear seasonal variation in ^{36}Cl flux with peaks in the spring (April or May). Similar spring maximum has been observed in other locations and for other cosmogenic radionuclides, e.g. ^{7}Be and ^{10}Be. As discussed in these studies, the seasonal pattern would be attributed to annual variation of tropopause height. The tropopause begins to rise rapidly in April or May at mid-latitudes (especially about 30-40 degrees N; Staley, 1962). As the tropopause rises, stratospherically produced ^{36}Cl is transported into the troposphere and washed out from the atmosphere after about one week. This mechanism would explain the observed results.

Yearly-averaged ^{36}Cl fluxes are 29, 30, 32 and 34 atoms m^{-2} s^{-1} for April 2004-March 2005, April 2005-March 2006, April 2006-March 2007, and April 2007-March 2008, respectively: 32 +- 2 atoms m^{-2} s^{-1} for 4 years. This value is in good agreement with the expected value from the latitudinal dependence of ^{36}Cl fallout (Lal and Peters, 1967) with recent estimates of the global mean production rate (Huggle et al., 1996; Masarik and Beer, 1999). Therefore, the effect of chlorine recycling (Scheffel et al., 1999) is not evident in the present study area. From the observed results, the natural background flux of meteoric ^{36}Cl is estimated to be about 30 atoms m^{-2} s^{-1} in Tsukuba.

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References

Huggle, D. et al. (1996) *Planetary and Space Science*, **44**, 147-151.
Lal, D. and Peters, B. (1967) in: *Handbuch der Physik*, Vol. 46/2, Sitte, K. (ed.), Springer, Berlin, pp. 551-612.
Masarik, J. and Beer, J. (1999) *Journal of Geophysical Research*, **104**(D10), 12099-12111.
Scheffel, C. et al. (1999) *Geophysical Research Letters*, **26**, 1401-1404.
Staley, D.O. (1962) *Journal of the Atmospheric Sciences*, **19**, 450-467.