Concentration and isotopic analysis of soil gas N_2O in a Japanese tea field

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N_2O is an important trace gas that causes global warming and is indirectly related to destruction of stratospheric ozone layer. Fields planted with tea (*Camellia sinensis*) in Japan have a high potential to emit large amount of N_2O because of the highest level of N fertilizer application. In this study, we focus on the processes leading to high N_2O production in an experimental tea field in Shizuoka, Japan for better arranging N_2O mitigation strategy.

Soil gas samples were collected at four depths in two plots (Plots I and II) at 3 to 7-day interval from May to July, 2012 for concentration and isotopic analysis of N_2O. Surface soils (0-20 cm) were also collected for the analysis of other N-compounds.

Three peaks of N_2O concentration were observed corresponding to fertilization on 8 June and 5 July 2012. Each peak was found after heavy precipitation and a rise in air temperature above 20ºC. The site preference of N_2O (SP, the difference in $^{15}N/^{14}N$ ratio between central (α) and terminal (β) N in $^{\beta}N^{\alpha}NO$) ranged from 0.8‰ to 11.1‰ at the N_2O concentration peaks, suggesting greater (64% to 95%) contribution of bacterial nitrite (NO_2^-) reduction than hydroxylamine (NH_2OH) oxidation or fungal denitrification. However, on one occasion (21 June at 35 cm depth of Plot I) N_2O had relatively high SP value (18.1‰), indicating an increase in production rate of NH_2OH oxidation or fungal denitrification relative to bacterial NO_2^- reduction.

Overall, N_2O in Japanese tea field was mainly produced by bacterial NO_2^- reduction under the effects of fertilization and precipitation in warmer (above 20 ºC) condition.

Clay mineral argon release during frictional shear experiments – Implications for brittle fault dating

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Brittle fault zones comprise synkinematic or authigenic clay minerals such as illite, which can be dated by conventional K-Ar or Ar-Ar dating using micro-encapsulation (Zwingmann *et al.*, 2010). A pre-requirement for dating authigenic fault illite invokes no inheritence of radiogenic Ar.

The retention of Ar in fine grained clay minerals such as illite, occuring in clay rich fault gouge zones, is difficult to measure in nature. Den Hartog *et al.* (2012) describe friction experiments on fine grained mixtures of illite and quartz, performed with the aim of determining the frictional properties and slip stability under (near) in situ subduction megathrust conditions, i.e. at an effective normal stress of 170 MPa, a pore fluid pressure of 100 MPa at 150-500°C and sliding velocities relevant to earthquake nucleation (1-100 μm/s). These experiments allow investigation of Ar isotope retention and diffusion aspects in artificial gouge samples. We present prelimenary conventional K-Ar age data on four artifically generated illite gouge samples, obtained from frictional shear experiments ranging from 150 to 450°C under the same pressure regime.

The original Rochester shale yields a Silurian age of 421.4 ± 8.4 Ma as described by Folk (1962). Low temperature (150 °C) frictional shearing experiments reduce the age of the artifical gouge to 218.3 ± 5.0 Ma, still containing more than 70% of radiogenic 40Ar. Ar diffusion modeling using a <2 micon clay fraction size indicates neglible diffusion aspects at a temperature of 150 °C. The age data suggests that the frictional shearing of clay gouge affects the clay microstructures and releases radiogenic Ar caused by processes reported in Den Hartog (2012). The 250, 350 and 450°C experiments yield artificial illite gouge ages of 155.0 ± 3.1 Ma, 139.5 ± 2.9 Ma and 74.7 ± 1.5 Ma, respectively. Argon diffusion modeling indicates that diffusion starts to affect the clay mineral gouge ages from 300°C. Further studies are in progress, investigating clay gouge noble gas retention and effects, to constrain timing of fault gouge reactivation in the seismogenic zone.

[1] Den Hartog *et al*. (2012) *EPSL* **353-354**, 240-252 [2] Folk (1962) *J. Sediment Petrol*. **32**, 539-578. [3] Zwingmann *et al*. (2010) *Geology* **38**, 487-490

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