Precambrian P-T-t history of the Yenisey Ridge as a consequence of contrasting tectonic settings in the western margin of the Siberian craton

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The Riphean evolution of the Yenisey Ridge was not marked by the prominent tectonic events except for the rift-related bimodal magmatism at ~1380 Ma. The closure of this basin was accompanied by the orogeny with deformation and metamorphism. The early stage is marked by the formation of low-pressure (LP) metamorphic complexes of the And-Sil type (T=400-650°C at P=3.3-5.2 kbar), indicating a normal metamorphic field gradient with dT/dH of about 25-35 °C/km. The relationship between this process and the Grenville-age orogeny was supported by the U-Pb and ^{40}Ar-^{39}Ar dating of metapelites from the Teya complex (~970 Ma). These LP/HT assemblages structurally overlie mid-crustal rocks of the Garevka complex that underwent medium-pressure (MP) metamorphism in the range from amphibolite- to granulite facies conditions of T=582-631ºC at P=7.72-8.64 kbar at depths of ca. 27-28 km.

Rocks closest to the thrusts underwent the MP metamorphism of the Ky-Sil type. A number of specific features and low metamorphic field gradient with dT/dH from 5-7 to 14°C/km are typical of collisional metamorphism during overthrusting of continental blocks, and are evidence of near-isothermal loading in accordance with the transient emplacement of thrust sheets and subsequent rapid exhumation. The proposed model suggests that, given an estimated exhumation rate of 0.368 mm/yr, the peak of collision-related metamorphic conditions occurred at 849-862 and 798-802 Ma.

The 849-862 Ma collisional evens are contemporaneous with the emplacement of low-alkali granite plutons responsible for the heating of rocks at a P=2.5-3.5 kbar, indicating a high gradient with dT/dH >100°C/km. Approximately at the same time (900-880 Ma) the mid-crustal amphibolite-facies rocks have experienced exhumation to a 14-16 km depth of upper-crustal structural levels. D_2-blastomylonites, which localized in narrow strike-slip fault zones, were re-equilibrated under LP conditions at 3.9-4.9 kbar associated with a low metamorphic field gradient with dT/dH ≤10°C/km.

The first occurrence of Siberian equivalents of the mid-Mesoproterozoic event, coupled with evidence of the Grenville-age orogenic events in the Yenisey Ridge, provide the basis for any paleoreconstructions showing a tight connection between Laurentia and Siberia in Rodinia configuration.

Developing models to assess fine scale energy change in soil organic matter under different forest managements

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The energy captured by primary productivity drives the biosphere but we do not view soil and SOM from an energetic perspective. SOM represents a complex thermochemical continuum from ordered energy rich macromolecules and assemblages through less ordered energy 'poor' aromatics and microbial byproducts. This complexity has been reduced conceptually and analytically into a 'black box' where biophysical parameters are summed into pools describing biological function and stability or turnover dynamics.

Simple conceptual models are useful for characterizing gross processes and rates such as ecosystem scale N cycling but fail to provide insight into long-term stability of C and energy dynamics. There is a dearth of information on the effect of simple or mixed litter inputs on SOM stability. Development of quantitative relationships between energy rich inputs and their transformation into a continuum of meta-stable SOM constituents is needed to support mechanistic understanding of ecosystem resilience related to disturbance, management and climate change. Differential Scanning Calorimetry- Thermogravimetry (DSC-TG) provides the flexibility, resolution and reproducibility to quantify distributions of thermochemical stability in soils and SOM across biophysical and management gradients to construct a mechanistic biophysical basis of SOM dynamics and stability.

We present results and models from long-term forestry experiments that manipulated N availability and litter inputs across varying soil mineralogy sequences. Our dataset (field replicated sample) supports robust DSC and TG models for statistical analyses on fine scale temperature subdivision bins (5-20°C). Thermal regions of significant energetic enrichment (associated with fertilization) or reduced litter diversity were detected. In both cases, the differences are apparent at the fine scale temperature subdivision but loose their clarity at coarse scales (150°C exothermic approach) or changes in soil C mass alone. In addition, we developed ratios and relationships between DSC-TG quantities and rates to detangle exotherm SOM signals from varying mineral constituents. These results illustrate the varying capacity of short-range order minerals to support the stability of new inputs or the release of existing SOM related to treatment. Our results illustrate the potential of numerical and modelling approaches to move from coarse aggregated metrics to process based relationships. This is a logical step towards developing a continuous and mechanistic understanding of the complex thermochemical nature of SOM.