Geodynamic kinetics: Metamorphic reaction rates in subduction zones

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Existing models of fluid release due to dehydration reactions in the subducting slab are based on the assumption that reactions approach equilibrium on timescales comparable to the rate of subduction. Yet there are no field-based measurements of the rates of prograde reactions in subducting slabs, making it difficult to assess the applicability of equilibrium thermodynamics in petrologic models of fluid release. The best constrained field-based metamorphic reaction rates are from regional metamorphic settings and describe a relatively robust relationship between temperature (T) and reaction rate (R_{net}):

$$\log R_{net} = 0.0077T - 12.1$$

Here we assess the applicability of regional reaction rates to fluid-producing reactions that occur during prograde metamorphism of subducting slabs.

We estimate the degree of reaction completion within a dynamic subdution setting by integrating the temperature dependence of regional reaction rates with a thermal model of a cold subduction zone (North Honshu) [1], assuming a subduction rate of 39 mm/yr. Our models show that regional reaction rates are considerably slower than subduction rates at temperatures below ~600°C, such that subduction would significantly outpace the progress of metamorphic reactions in the slab. In order to create the assemblages exhumed in subduction channels (e.g., blueschist, eclogite), either (1) grain sizes must be very small; for instance, on the order of 100 μm or less, or (2) the kinetic environment of the subducting slab is fundamentally different than in other regional metamorphic settings. We propose that the dynamic nature of subduction zones (high dT/dt) results in conditions that are far from equilibrium (large ΔG_{rxn}), driving faster reaction rates in these systems. The dramatic increase in dT/dt at ~80 km slab depth due to slab-mantle coupling would then drive dehydration reactions in a race to "catch up" to the thermal state of the slab, the result of which would be a pulse of fluid released at around this depth. Thus even continuous reactions could run to completion over a relatively short depth interval, explaining the pulse-like fluid release inferred from some arc magmas and exhumed subduction terranes.

[1] Syracuse *et al*. (2010) *Phys Ear Planet Int* **183,** 73–90.

Interrelation between tuffs and organic rich source rock in Chang7 Formation, Triassic, Ordos Basin, Central China

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Organic rich source rocks development modles and controlling factors were summarized. Modles is including black sea molde, the upwelling molde, and hydrotherm modle. The controlling factors are primary production, anoxic enviroment, and sedimentation rate. Interrelation between organic rich sedimentation rate and tuff in the Ordos basin was reported rarely and tuff may erupted by the active of Qinling mountain orogeny and Sublacustrine hydrothermal activity. We used organic geochemistry and inorganic trace mentals to analyzed the source rock and tuff of T_3y, Ordos basin, central China after core fine description.

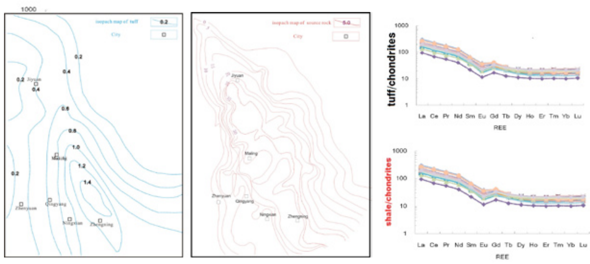

Fig.1 Comparisons of the distibution and REE of Tuffs and source rocks

Interrelation of tuffs and high quality source rocks determinted by the following evidences,

1) The tuffs were interbed the Chang7 high quality source rock and have the same distribution in the Ordos Basin, especially in the Chang7[3] oil subformation.

2) Tuffs and the source rocks have the same Rare earth element (REE) distribution, which indicate the same source. Tuff contribute nutrient elements (P, Fe and N) for organic rich shale developemnt.

3) Paleo-depth and paleo-salinity analyses indicated the water is fresh and the maximum water depth are below 120m.Organic rich shale development mode is tuff simulation the mass plankton growth, which lead to high TOC.

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