

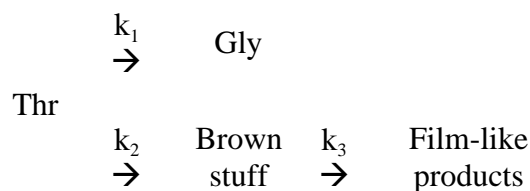
Competition of polymerization and decomposition upon heating of an amino acid simulating the chemical evolution

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Although a large number of simulation experiments has been conducted for the the chemical evolution toward life, little is known on the transformation mechanisms and kinetics of organic molecules and suitable environments for the chemical evolution. Most previous studies have been focused on the question whether polymers were formed or not. However it is important to evaluate conditions and time scales of polymerization processes.

In order to study kinetic competition of polymerization against decomposition of amino acids, a series of kinetic experiments has been conducted for the thermal transformation of 0.1mol/l threonine (Thr) by using thermocouple-monitored reaction vessels on hot plates. The reaction products were analyzed by HPLC and UV-visible spectroscopy. At temperatures of 120 to 160°C. Thr decomposed into glycine (Gly), while the solution turned into brown and a film-like product (possibly polyester-like polymer) was formed on the solution surface. The changes with time of Thr and Gly concentrations by HPLC and the brown stuff content by UV absorbance were fitted numerically based on the following reaction schema by assuming the 1st order reactions.



The obtained apparent rate constants $k (=k_1+k_2)$ showed a good agreement with the literature data for the decrease rate of Thr (Valentyne, 1964). However the k_1 and k_2 values showed different slopes in an Arrhenius diagram. These two slopes for k_1 and k_2 have a crossing points around 140°C. At temperatures under 140°C, the polymerization reaction has larger rate constants (k_2) than the decomposition (k_1). Therefore excessive high temperatures are considered to be unfavorable environment for the polymerization reaction, because of the faster rates of decomposition reaction.

Reference

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Carbonatite compositions related to geological settings

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As well known, there are many kinds of carbonatite with different composition in the world. In this study, it was divided into two groups in terms of composition. The first category ranges from dolomitic with $Mg\# > 80$ to calcitic carbonatite and the other one is ferrocarbonatite with $Mg\# < 80$. For example, the carbonatites in the hotspots of Cape Verde islands and Canary Islands as well as the Spitskop Complex in Kaapvaal craton are type one. The oceanic rift carbonatite in the northern Oman Mountains is type two. The carbonatites in the Eastern African Rift are both type one and type two.

The hotspot dolomitic carbonatite at > 200 km in depth and reacts with orthopyroxene to form more calcite-riche products at the depth less than ~ 100 km. The previous study indicated that $Mg\# (> 80)$ of carbonatite would not change with the rising of magma (Dalton & Wood 1993). Also it was observed that the original magma of oceanic rift carbonatite occurred at shallow mantle with the temperature considered to be close to dry peridotite solidus because of its high content of SiO_2 (Moore & Wood 1998) and FeO. Additionally, the silica-undersaturated melt would separate into silicate and carbonatite with decreasing temperature. All in all, the variation of carbonatite composition depends on its depth of generation and the PT conditions for evolution, and the carbonatites in the Eastern African Rift are considered to be higher Fe content with thinning of cratonic lithosphere.

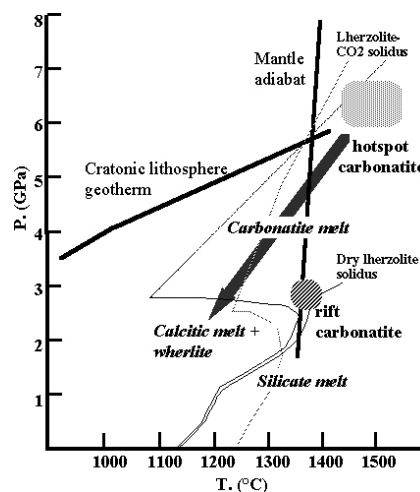


Figure 1: Lherzolite solidus and geotherms

References

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