Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33877

Amide synthesis from amines and esters in hydrothermal fluids

ZIMING YANG, PRINCE BROWN AND ALEXANDRIA ASPIN

Oakland University

Amides are the backbone of peptides and proteins that are essential for life on early and present Earth. Abiotic synthesis of amides is feasible in natural hydrothermal environments, but the reaction pathways and mechanisms are not well-understood. In this study, we investigate the potential of ester aminolysis under hydrothermal conditions at 250 °C and P_{sat}. Among the studied substrates, ethyl acetate with benzylamine yields the highest amide concentration, followed by ethyl acetate with cyclohexylamine and ethyl benzoate with benzylamine. Time-series experiments reveal that a dominating pathway initiates with hydrolysis of ester to form carboxylic acid, followed by the condensation between the acid and amine. The reaction proceeds more efficiently under neutral and basic than acidic conditions, suggesting the protonation of amines at lower pH inhibits the amide formation. The effects of common metal salts, such as NaCl, $FeCl_3$, $FeCl_2$, $CuCl_2$, and $ZnCl_2$, on amide hydrothermal synthesis are also studied, in which all tested metal salts show an inhibition on the amide yield. In the phosphate-buffered experiments, however, most of the metal salts show an increase in amide formation compared to the non-buffered experiments, suggesting the inhibition from the metal salts is caused by the decrease of pH in dissolved metal solutions. These findings suggest another feasible synthetic pathway of amides under hydrothermal conditions, which is subject to the solution pH and complexation with metal ions.