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Evolution of Wangtu Gneissic Complex and its paleogeographic implications in Columbia assembly: insights from geochemistry, geochronology, and computational phase-equilibria study

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A part of Palaeoproterozoic granite-gneiss complex, commonly known as Wangtu Gneissic Complex (WGC), exposed in Wangtu-Karcham-Akpa region along the Sutlej valley, northwest lesser Himalaya, India. The core part of this gneissic complex is exposed as the undeformed granitoid body. The basement of WGC is still more or less in its primeval condition. The Paleoproterozoic thermal evolution of the North Indian Continental Margin is uncertain as the Lesser Himalayan granites are viewed either as a subduction-zone volcanic arc or rift-related magmatism during the Columbia assembly or disintegration process. Integrated mineralogical, geochemical analyses, temperature calculations of Ti solubility in biotite and zircon, and computational phase equilibria modelling of the Wangtu Gneissic Complex (WGC), Himachal Himalaya show a peraluminous existence for most WGC rocks that crystallize at a temperature of ~650°C at a pressure of ~1.0-1.1 GPa. The WGC magmatic zircons' U-Pb ages indicate two significant age groups at 1867 Ma and 2487 Ma.

The U-Pb zircon data and model phase equilibria for metasedimentary rock show the generation of S-type peraluminous magma parental to the WGC, by melting pre-existing supracrustal rocks at ~ 1800 Ma, at temperature ~ 850-900 ° C and pressure 1.1-1.2 GPa, identical to P-T conditions found in modern-day subduction zone settings. Also, T_{DM} model ages vary between 3.07 Ga and 2.28 Ga, and $f^{Sm/Nd}$ values (-0.4930 to -0.3510) of the studied samples suggest a contribution of Achaean crust. This study shows that the North Indian Continental Margin was an active subduction zone during the Paleoproterozoic Columbia supercontinent assembly.