

The Palaeozoic–Mesozoic tectonic evolution of Central Asia, including the vast terrane collage that makes up Mongolia, has been a topic of considerable debate. The Oyut Ulaan Volcanic Group is a sequence of volcanic and sedimentary rocks in SE Mongolia that forms the southern part of the Devonian–Permian Saykhandulaan Inlier. Fieldwork traverses and mapping have established four distinct formations in the Oyut Ulaan Volcanic Group that record the nature of arc activity in part of the Central Asian Orogenic Belt during the Carboniferous. Physical volcanological and sedimentological characteristics of the four formations suggest three clear eruptive styles: (1) periodic andesite volcanism in an actively eroding arc setting that also contained large rivers and swamps; (2) highly effusive plateau andesite volcanism; (3) explosive rhyolitic effusion. Geochemical analyses of volcanic lithologies suggest that the group represents subduction-related, mature, continental arc volcanism. Geochemical results document an evolving magma system to which surface processes of the volcano-sedimentary model may be linked. Magma pulses and replenishments are identified from variations in chemostratigraphy. Newly obtained zircon ages from the volcanic succession fix its emplacement (eruption) at 323.0 ± 0.7 Ma (mid-Carboniferous or late Mississippian). A granite cobble from the lower part of the Oyut Ulaan Volcanic Group gives a U–Pb zircon age of 338.9 ± 0.4 Ma indicating that arc plutons were emplaced 10 Ma prior to the Oyut Ulaan volcanism and were eroded soon after. Our work provides timing constraints for final accretion and continental assembly in SE Mongolia, and also sheds light on the petrological development of a magmatic arc system within an evolving accretionary orogen.