Abstract

The Bundelkhand giant quartz reef system is arguably unique in terms of the dimension and frequency of occurrence in a cratonic interior. The Bundelkhand granitoid (BG) constituting the bulk of the craton is exposed over an area of 26000 square k.m. and hosts 20 major reefs each extending for several tens of k.m. (some of them exceeding 100 k.m. in strike length) as discontinuous ridges trending NE-SW controlling the geomorphology of the terrane. These giant reefs are associated with numerous smaller reefs at variable orientations with respect to the major reefs. The giant reefs are mostly linear to slightly curvilinear in trend. Fluid regime in these giant quartz reefs bear imprints of interplay of meteoric fluid and a fluid of moderate salinity and temperature that can be best visualized as an evolved fluid from BG. Signatures of high temperature metamorphic fluid of any deep crustal derivation is largely lacking. Aqueous fluid inclusions studied in matrix quartz in BG and minor quartz / quartzofeldspathic veinlets therein, furnish temperature and salinity ranges that are similar to the fluid characteristics in the giant quartz reefs. This led to the inference that the late-stage evolved fluid in BG is the most feasible source for the fluid that formed these giant reefs on major fracture zones. The process was controlled by flow of fluid as a result of pressure difference between the fracture zones and the host granite. The fluid in the fracture zones eventually mixed further with meteoric fluid that facilitated deposition of quartz and thus the host BG is surmised as the main source of silica for the reefs and the process is visualized to have operated within the shallow crustal regime, not exceeding 3 to 5 k.m. Other than just the similarity in temperature-salinity characteristics, occurrence of aqueous inclusions with suspended tiny hydrous silicate minerals in both domains help in further establishing a genetic link between the giant quartz reefs and BG. Besides, occurrence of captive tiny hydrous silicate minerals along with anhydrous solid phases in fluid inclusions identified from Raman spectroscopy point towards a 'silicothermal' or 'hydrosilicic' stage through which the exsolve fluid from BG magma possibly evolved and continued evolving to a moderate salinity-temperature fluid with possible incursion of meteoric fluid. BG evolved from mid-crustal depths (~6 kilo bars pressure and temperature of about 900°C) to shallow depths as indicated from mineral chemistry of primary plagioclase, hornblende, apatite and biotite and the intermediate stages of re-equilibration with fluid as indicated from biotite, to low-temperature hydrothermal stages imprinted in compositions of chlorite and epidote. The intermediate temperature stages of evolution of fluid is irretrievable from fluid inclusions due to the limitation of determination of temperature of total homogenization of aqueous-carbonic inclusions representing the early fraction of CO_2-charged fluid that exsolved from BG magma. Geochemical modelling of fluid mixing qualitatively supports a fluid mixing process for formation of the giant reefs. Numerical modelling of a dissolution-advection-diffusion transport model indicates that such process could explain the formation of the giant quartz reef system although prediction of the exact time span of formation would need further refinement of the model. The Bundelkhand giant quartz reef system does not compare favourably with any world occurrence of classic shear-zone controlled quartz reefs in collisional orogens where deeper source of silica and fluid are envisaged. Data

generated in the present work leads to a model akin to ‘**geothermal systems operating in shallow crust in extensional deformation regime** for the Bundelkhand giant quartz reef system, nonetheless, awaits more information for validation of the model.