

Edge Tectonics (Trench Rollback, Terrane Export) of Gondwanaland-Pangea Synchronized by Supercontinental Heat

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Abstract

From 650–500 Ma assembly, 320 Ma merger in Pangea, to 185 Ma breakup, Gondwanaland developed by the accretion of lithosphere along the convergent edge on the south and by the export of terranes from the divergent edges on the west and northeast. The interior underwent epeirogenic movement except in areas affected during the merger by farfield shortening. Synchronous or near-synchronous events on the edges and interior are linked hypothetically by convection currents in the asthenosphere driven by supercontinent-induced heat. On the convergent edge, currents countered the sinking slab to roll back the trench and generate a backarc basin. On the divergent edge, currents initiated an ocean that prised off continental rims in the form of terranes. In the interior, currents extended the lithosphere in basins and rifts.

Key words: Gondwanaland, Pangea, rollback, terranes, breakup.

A Quantitative Structural Study of Late Pan-African Compressional Deformation in the Central Eastern Desert (Egypt) During Gondwana Assembly

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Abstract

The Arabian-Nubian-Shield (ANS) is composed of a number of island arcs together with fragments of oceanic lithosphere and minor continental terranes. The terranes collided with each other until c. 600 Ma ago. Subsequently, they were accreted onto West Gondwana, west of the present River Nile. Apart from widespread ophiolite nappe emplacement, collisional deformation and related lithospheric thickening appear to be relatively weak. Early post-collisional structures comprise not only extensional features such as fault-bounded (molasse) basins and metamorphic core complexes, but also major wrench fault systems, and thrusts and folds. The Hammamat Group was deposited in fault-bounded basins, which formed due to N-S to NW-SE directed extension. Hammamat Group sediments were intruded by late orogenic granites, dated as c. 595 Ma old. A NNW-SSE-oriented compression prevailed after the deposition of the Hammamat Sediments. This is documented by the presence of NW-verging folds and SE-dipping thrusts that were refolded and thrust in the same direction. Restoration of a NNW-SSE-oriented balanced section across Wadi Queih indicates more than 25% of shortening. Transpressional wrenching related to the Najd Fault System followed this stage. The wrenching produced NW-SE sinistral faults associated with positive flower structures that comprise NE-verging folds and SW-dipping thrusts. Section restoration across these late structures indicates 15–17% shortening in the NE-SW direction. At a regional scale, the two post-Hammamat compressional phases produced an interference pattern with domes and basins. It can be shown that the Najd Fault System splays into a horsetail structure in the Wadi Queih area and loses displacement towards N and NW. The present study shows a distinct space and time relationship between deposition of Hammamat Group/late-Pan-African clastic sediments and late stages of Najd Fault wrench faulting: Hammamat deposition is followed by two episodes of compression, with the second episode being related to Najd Fault transpression. Therefore, the Hammamat sediments do not represent the latest tectonic feature of the Pan-African orogeny in the ANS. The latest orogenic episodes were the two successive phases of compression and transpression, respectively. It is speculated that extension during (Hammamat) basin formation was sufficiently effective to reduce the thickness of the orogenic lithosphere until it became gravitationally stable, and incapable of further gravitational deformation.

Key words: Pan-African, Arabian-Nubian Shield, section restoration, late-orogenic structure, transpression.

Titanosaur (Dinosauria: Sauropoda) Osteoderms from the Maastrichtian of Uberaba, Minas Gerais State, Brazil

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Abstract

Titanosaur remains are common findings at the paleontological site of Peirópolis in Uberaba. Among those remains, two osteoderms referred to titanosaur sauropods were reported. Both dermal bones share many features, such as the coarse texture, parallel ventral grooves, lack of the *cingulum* and presence of a ventral ridge (crest). Armored titanosaurs had wide distribution in the Upper Cretaceous, and have been reported from Argentina, Brazil, France, Madagascar, Malawi, Romania and Spain. In the present work we describe and compare the Brazilian titanosaur osteoderms found thus far.

Key words: Dinosaur, titanosaur, osteoderm, Late Cretaceous, Uberaba.

Evolution of Heterogeneous Mantle in the Acampamento Velho and Rodeio Velho Volcanic Events, Camaquã Basin, Southern Brazil

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Abstract

The Camaquã Basin, developed during the last phases of the Brazilian/Pan-African Orogeny and was filled with a thick volcano-sedimentary succession, in which two volcanic events of alkaline affinity are represented by the Acampamento Velho Alloformation and the Rodeio Velho Member. The Acampamento Velho Alloformation records a bimodal event with a lower association of mafic flows and an upper association of felsic pyroclastic rocks and flows. It was formed during extension, after the subduction of the Adamastor oceanic plate beneath the Rio de La Plata continental plate at the end of the Neoproterozoic III. The second event, the Rodeio Velho Member, represented by mafic flows, intrusions and piroclasts, took place during overall extensional tectonism, probably in the middle Ordovician. Rb, Sr, Sm, and Nd isotopic measurements were carried out on samples from both units. Regardless the event they represent, all the samples display negative values for epsilon Nd, ranging from -2.97 to -10.31 for the Acampamento Velho Alloformation and from -8.39 to -13.92 for the Rodeio Velho Member. The initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratios vary from 0.706 to 0.707 and from 0.704 to 0.707 for the Acampamento Velho Alloformation and Rodeio Velho Member, respectively. Mafic flow deposits in both units show a preferential enrichment in Ba relative to Th. Flow samples from the Rodeio Velho Member also display a distinctive enrichment in the Ba/Th ratio, without a change in the initial Sr, compared to the mafic flow deposits from the Acampamento Velho Alloformation, which show a slight enrichment in those ratios. As for the Acampamento Velho Alloformation, the mafic lavas could be a mixture of depleted mantle-derived basalts plus 20% to 30% of crustal contamination by sediment (probably Neoproterozoic arkosic quartzites). The formation of a magmatic chamber and the separation of the magma into two fractions gave rise initially to the mafic rocks at the base of the Acampamento Velho Alloformation. The other magma fraction underwent a significant enrichment in crustal component before the felsic rocks of this Alloformation were formed. The flows from the Rodeio Velho Member originated in a distinct magma chamber, with EM I characteristics that was much more enriched in incompatible elements and depleted in radiogenic Sr.

Key words: Volcanic rocks, Brasiliano/Pan-African orogeny, isotopic signature, crustal contamination, Camaquã Basin.

Multiple Foliations Defined by Different Sillimanite Crystal Habits, Partial Melting and the Late Metamorphic Development of the Cannington Ag-Pb-Zn Deposit, Northeast Australia

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Abstract

A succession of foliations defined by different sillimanite-bearing structural fabrics suggests that the macroscopic, isoclinal synform that dominates the geometry of the Cannington Ag-Pb-Zn deposit, northwest Queensland, Australia formed during D_2 . The five foliations in this succession, S_1 to S_5 , are defined by aligned sillimanite with habits ranging from individual crystals in S_1 through S_4 to clusters of fibrolite in S_5 in both the matrix and as inclusion trails within garnet and gahnite (Zn-rich spinel) porphyroblasts. S_1 , S_3 and S_5 formed as sub-horizontal foliations, whereas S_{1a} , S_2 and S_4 formed sub-vertically. Foliation intersection/inflexion axes (FIAs) within garnet and gahnite porphyroblasts preserve a succession of trends that shifts from W-E to N-S. This succession indicates that this region experienced N-S followed by W-E bulk crustal shortening. N-S shortening occurred during D_1 and D_{1a} , and W-E shortening occurred from D_2 to D_5 . Prismatic and rhombic sillimanite produced during D_1 - D_4 accompanied prograde metamorphism to ca. $634 \pm 62^\circ\text{C}$ and 4.8 ± 1.3 kbar. The coexistence of fibrous, prismatic and rhombic sillimanite resulted from post peak metamorphic reactivation of the early foliations during D_5 . The synformal D_2 fold was intensified during D_4 by W-E bulk shortening. Local partial melting occurred after D_1 in the appropriate bulk rock compositions, based on calculation of P - T pseudosections in the chemical systems KFMASH, KFMASHTO, NCKFMASH and MnNCKFMASH. Zn mineralization related to gahnite growth occurred during D_3 through D_4 , and was redistributed by partial melting into structural and rheological sites during D_4 and D_5 shearing.

Key words: Sillimanite, gahnite, foliation intersection/inflexion axes, partial melting, Zn mineralisation.

A Middle Ordovician Drowning Unconformity on the Northeastern Flank of the Okcheon (Ogcheon) Belt, South Korea

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Abstract

The Maggol Limestone of Ordovician age was deposited in the Taebaeksan (Taebaeksan) Basin which occupies the northeastern flank of the Okcheon (Ogcheon) Belt of South Korea. Carbonate facies analysis in conjunction with conodont biostratigraphy suggests that an overall regression toward the top of the Maggol Limestone probably culminated in subaerial exposure of platform carbonates in the early Middle Ordovician (earliest Darriwilian). Elsewhere this subaerial exposure event is manifested as a major paleokarst unconformity at the Sauk-Tippecanoe sequence boundary beneath the Middle Ordovician succession and its equivalents, most in notably North America and North China. Due to its global extent, this paleokarst unconformity has been viewed as a product of second- or third-order eustatic sea level fall during the early Middle Ordovician. The Sauk-Tippecanoe sequence boundary in South Korea, however, appears to be a discrete marine-flooding surface in the upper Maggol Limestone. Strata beneath this surface represent by a thinning-upward stack of exposure-capped tidal flat-dominated cycles that are closely associated with multiple occurrences of paleokarst-related solution-collapse breccias. This marine-flooding surface is overlapped by a thick succession of thin-bedded micritic limestone that is eventually overlain by a Middle Ordovician condensed section. This physical stratigraphic relationship suggest that second- and third-order eustatic sea level fall may have been significantly tempered by regional tectonic subsidence near the end of Maggol deposition. The tectonic subsidence is also evidenced by the occurrence of coeval off-platform lowstand siliciclastic quartzite lenses as well as debris flow carbonate breccias (i.e., the Yemi Breccia) in the basin. With continued tectonic subsidence, a subsequent rise in the eustatic cycle caused drowning and deep flooding of the carbonate platform, forming a discrete marine-flooding surface that may be referred to as a drowning unconformity. This tectonic interpretation contrasts notably with the slowly subsiding carbonate platform model for the basin as has been previously suggested. Thus, it is proposed that the Taebaeksan Basin in the northeastern flank on the Okcheon Belt evolved from a slowly subsiding carbonate platform to a rapidly subsiding intracontinental rift basin during the early Middle Ordovician.

Key words: Middle Ordovician, South Korea, Okcheon Belt, intra-continental rift basin, drowning unconformity.

Sr, Nd and Pb Isotopic Systematics of the Cenozoic Basalts of the Korean Peninsula and Their Implications for the Permo-Triassic Continental Collision Boundary

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Abstract

Sr, Nd and Pb isotopic compositions of the Cenozoic basalts were analyzed from Baengnyeongdo Island, Jeongok, Ganseong, and Jeju Island of Korea. They reveal relatively enriched Sr and Nd isotopic compositions ($^{87}\text{Sr}/^{86}\text{Sr} = 0.70330\sim 0.70555$, $^{143}\text{Nd}/^{144}\text{Nd} = 0.51298\sim 0.51256$) compared with MORB. $^{207}\text{Pb}/^{204}\text{Pb}$ and $^{208}\text{Pb}/^{204}\text{Pb}$ values of all the analyzed Korean basalts lie above the Northern Hemisphere Reference Line (NHRL) defined by Hart (1984). Pb isotopic compositions of basalts from Jeju Island ($^{206}\text{Pb}/^{204}\text{Pb} = 18.61\sim 19.12$, $^{207}\text{Pb}/^{204}\text{Pb} = 15.54\sim 15.69$, $^{208}\text{Pb}/^{204}\text{Pb} = 38.98\sim 39.72$) are significantly more radiogenic than the rest ($^{206}\text{Pb}/^{204}\text{Pb} = 17.72\sim 18.03$, $^{207}\text{Pb}/^{204}\text{Pb} = 15.44\sim 15.58$, $^{208}\text{Pb}/^{204}\text{Pb} = 37.77\sim 38.64$). The Cenozoic Korean basalts thus can be divided into two groups based on their Sr, Nd and Pb isotopic compositions. The north group reveals mixing between DMM and EM1 while the south group displays DMM-EM2 mixing. Such a distribution is the same as Chinese Cenozoic basalts and it can be interpreted that the subcontinental lithospheric mantle under Korea represents simple lateral continuation of the South and North China Blocks. We suggest that Korean continental collision zone cross the Korean Peninsula through the region between the north and south basalt groups of Korea.

Key words: Cenozoic basalt, subcontinental lithosphere, continental collision, enriched mantle component, Korean peninsula.

Genetic Implications of Two Different Ultramafic Rocks from Hongseong Area in the Southwestern Gyeonggi Massif, South Korea

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Abstract

Two distinct ultramafic bodies occur in Baekdong and Bibong in the Hongseong area within Gyeonggi massif of South Korea. The Hongseong area is now extensively documented as an extension of the Dabie-Sulu collision belt in China. The Baekdong ultramafic body has a NWW elongation direction. This elongation trend is similar to the general trend of the Dabie-Sulu collision belt. The Bibong ultramafic body is elongated in a NNE direction and runs parallel to the direction of the main fault in the study area. The Baekdong ultramafic bodies show porphyroclastic and mylonitic textures while those at Bibong exhibit a mosaic texture. Both were grouped into peridotite and serpentinite based on their modal abundance of serpentine. In the olivine (Fo) vs. spinel [$Cr\# = Cr / (Cr + Al)$] diagram, both ultramafic rocks fall with in olivine spinel mantle array. The compositions of olivine, orthopyroxene and spinel indicate that the Baekdong ultramafic rock formed in deeper parts of the upper-mantle under passive margin tectonic setting. The ΣREE content of Baekdong ultramafic rock vary from 0.19 to 5.7, exhibits a flat REE pattern in the chondrite-normalized diagram, and underwent 5% partial melting. Conversely, large variation in ΣREE (0.5–21.53) was observed for Bibong ultramafic rocks with an enrichment of LREE with a negative slope and underwent 17–24% partial melting. The Baekdong ultramafic rocks experienced three stages of metamorphism after a high pressure residual mantle stage. The first stage of metamorphism occurred under the eclogite-granulite transitional facies (1123–911°C, > 16.3 kb) the second under the granulite facies (825–740°C, 16.3–11.8 kb) and the third is the retrogressive metamorphism under amphibolite facies (782–718°C, 8.2–8.7 kb) metamorphism. The Baekdong ultramafic rocks had undergone high-P/T metamorphism during subduction of the South China Block, and experienced a fast isothermal uplift, and finally cooled down isobarically. Evidences for metamorphism were not identified in Bibong ultramafic rocks. Hence, the Baekdong ultramafic rocks with in the Hongseong area may indicate a link on the Korean counterpart of Dabie-Sulu collision belt between North and South China Blocks.

Key words: Gyeonggi massif, Baekdong, Bibong, ultramafic rock, collision.

Geology, Geochemistry and Tectonic Significance of Mafic-ultramafic Rocks of Mesoproterozoic Phulad Ophiolite Suite of South Delhi Fold Belt, NW Indian Shield

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Abstract

A thick sequence of mafic-ultramafic rocks, occurs along a major shear zone (Phulad lineament), running across the length of Aravalli Mountain Range for about 300 kms. It has been suggested, that this sequence may represent a fragment of ophiolite or a rift related metavolcanic suite made up of basalts and fractionated ultramafics. The geological and tectonic significance of the complex is assessed using field relationships, petrography and geochemistry. Structurally, the lowest part of the complex comprises a discontinuous band of plastically deformed harzburgite (mantle component) followed by layered cumulus gabbroic rocks (crustal component). A complex of non-cumulus rocks comprising hornblende schists, gabbros, sheeted dykes and pillowed basalts structurally overlies layered gabbros. Huge bodies of diorite intrude volcanics.

Geochemical classification suggests that all non-cumulus mafic rocks are sub-alkaline basalts except one variety of dykes which shows mildly alkaline character. The sub-alkaline rocks are tholeiite to calc-alkaline with boninite affinity. Tectono-magmatic variation diagrams and MORB normalised patterns suggest a fore arc tectonic regime for the eruption of these rocks.

The mafic rocks of Phulad Ophiolite Suite are zoned across the strike in terms of their distribution from west to east. The hornblende schists and basalts are exposed at the westernmost margin followed by gabbros and dykes. The alkaline dyke occurs at the easternmost part. The rocks of Phulad suite are juxtaposed with shallow water sediments in the east followed by platformal sediments and then continental slope sediments in the further east indicating gradual thickening of the crust from west to east and an eastward subduction. The geochemical interpretation presented in this study, together with discussion of lithological association is used to decipher the tectonic evolution of the Mesoproterozoics of NW Indian shield.

Key words: North West Indian Shield, Phulad suture, Mesoproterozoic ophiolite, boninite, alkaline basalt.

Cooling History of the Puttetti Alkali Syenite Pluton, Southern India

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Abstract

The Puttetti alkali syenite pluton in southern India belongs to the suite of felsic magmatic intrusives emplaced during the Late Neoproterozoic-Cambrian time during the final phase of amalgamation of the Gondwana supercontinent. In this study, we evaluate the cooling history of this pluton based on various isotopic systems. We present whole-rock Pb-Pb data on the syenite which yields an isochron age of 508 ± 25 Ma. Three phlogopite separates from the syenite pluton give K-Ar ages of 454.0 ± 9.0 , 448.5 ± 8.9 and 445.6 ± 8.8 Ma indicating cooling age at temperatures of $\sim 415^\circ\text{C}$. U-Pb analyses of zircons from this syenite yielded an age of 572 ± 2 Ma in a previous study. With U-Pb closure temperatures $> 800^\circ\text{C}$, this age probably indicates the timing of emplacement of the Puttetti pluton. Collectively, we estimate from the isotopic age data and respective closure temperatures that the syenite body cooled at about $3.2^\circ\text{C}/\text{Ma}$ from about 800°C to about 415°C . The markedly low cooling rate of the syenite pluton, absence of chilled margin effects, and common occurrence of pyroxene, feldspar, phlogopite and zircons megacrysts in the rock indicate that the host granulites were at high temperatures during the emplacement of the syenite magma. The cooling history of Puttetti syenite estimated in this study is closely comparable with the $3\text{--}4^\circ\text{C}/\text{Ma}$ cooling rate estimated for a granite pluton in a previous study from Madagascar. Our study suggests protracted cooling rates for the late Pan-African intrusives emplaced within the Gondwana crust, with a long residence history in a hot crust bore they were exhumed to shallower levels.

Key words: Pb-Pb geochronology, K-Ar ages, cooling history, Puttetti syenite, Gondwana.

CORRESPONDENCE

Spherules from the Late Cretaceous Phosphorite of the Fatehgarh Formation, Barmer Basin, India

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Abstract

A first report of discovery of spherules, glassy balls, highly magnetic fine dust and microbracciaded matrix in the Fatehgarh Formation of Barmer Basin, Rajasthan, India is being presented in this paper. The Fatehgarh Formation is a mixed siliciclastic, carbonate and phosphorite formation of Cretaceous age in the Barmer Basin that comprises sediments of Middle Jurassic to Lower Eocene age. The phosphorite zone in the Fatehgarh Formation is ~8 metre-thick zone that comprises phosphatic sandstone, bone bed, bedded phosphorite and phosphatic and non phosphatic gastropod beds. The spherules occur in a thin phosphatic-clay mud and silt band of bone bed, which also yielded a very rich and diverse microvertebrate assemblage with a dominant Late Cretaceous (Maastrichtian) form of *Igdabatis* along with forms comprising of *Semionodontid*, *Lapisosteum* and *Enchodontid*. The end Cretaceous is marked for a mass extinction of numerous species including dinosaurs. An extraterrestrial impact is interpreted as the reason for this mass extinction. Whether these spherules are related to the volcanic source or K/T Boundary impact ejecta found at Caribbean and Gulf of Mexico region needs detailed chemical and age characterization for which study is in progress.

Key words: Fatehgarh Formation, Barmer Basin, phosphorite, spherules, KTB.

CORRESPONDENCE

Aftershock Propagation Characteristics During the First Three Hours Following the 26 December 2004 Sumatra-Andaman Earthquake

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Abstract

Within three hours of the mainshock rupture of the 26 December 2004 Sumatra-Andaman earthquake, 45 aftershocks occurred that are distributed all along the mega-thrust fault plane and also along the West Andaman fault. Seven of these aftershocks struck sequentially and unilaterally from the mainshock in the south towards north within 2h 9m 50.76s indicating an overall rate of aftershock propagation to the tune of 167 meters/sec. Seismic moment calculated from fault parameters gives a value of 1.2×10^{30} dyne cm. Three separate fault segments are identified from distribution of aftershocks with propagation rates 330, 250 and 85 meters/sec in the southern, central and northern segments. These 7 unilaterally propagating shocks along the mega-thrust are probably not aftershocks of the mainshock rather these are sequentially triggered shocks each rupturing a small segment of the fault. Location of the mainshock and several aftershocks are guided by several lithospheric hinge faults identified previously.

Key words: Sumatra-Andaman earthquake, aftershock propagation, triggered shock, fault segment, rupture velocity.

CORRESPONDENCE

Remnants of Early Continental Crust in the Amgaon Gneisses, Central India: Geochemical Evidence

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Abstract

The Central Indian continental crust is postulated to have formed around the Archean nuclei of the Bastar Craton (Radhakrishna, 1993). Around 3.5 Ga. Old, high- Al_2O_3 trondhjemite gneisses have been reported from the southern part of the Bastar Craton (Sarkar et al., 1993). However, neither isotopic nor geochemical evidence exists in the literature for the presence of rocks older than ~ 2.5 Ga from the northern part of the Bastar Craton (Sarkar et al., 1990). The absence of tonalite-trondhjemite-granodiorite (TTG) suites from the Amgaon Gneisses (Rao et al., 2000), were considered to indicate substantial geochemical differences between the Amgaon gneisses and the TTG basement gneisses of the Dharwar Craton (i.e., the peninsular gneisses). Accordingly the mode of the tectonomagmatic evolutionary patterns of the Bastar Craton was considered to be different, both in time in space from the bordering Dharwar and Bundelkhand Cratons, respectively. In this communication we report the presence of high- Al_2O_3 trondhjemite from the Amgaon gneisses, along with calc-alkaline and peraluminous granites that are geochemically similar to the late granitoids (~ 2.5 to 2.6 Ga old) of the Dharwar Craton, suggesting that the two cratons were nearest neighbours at least during the late Archean.

Key words: Amgaon Gneisses, TTG suites, high- Al_2O_3 trondhjemites, Bastar Craton, late Archean.

CORRESPONDENCE

Petrological and Geochemical Constraints on the Evolution of the Alkaline Complex of Koraput in the Eastern Ghats Granulite Belt, India

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Abstract

The Koraput Alkaline Complex in the high-grade Eastern Ghats Belt, India, is synkinematically emplaced in a pull-apart structure and far from the Bastar cratonic margin. The suite comprises four distinct members, namely, mafic syenite, felsic syenite, nepheline syenite and perthite syenite. Fe-rich orthopyroxene rims on olivine in mafic syenite indicate iron-enrichment in the early stage of differentiation. With plagioclase of andesine composition it could be described as alkali-norite, the plutonic equivalent of hawthornite. Felsic syenite with both alkali-feldspars and plagioclase of oligoclase composition could be described as two-feldspar syenite, the plutonic equivalent of mugearite. Albitic rims on nepheline indicates subsolvus reaction. Chemical trends in amphiboles and plagioclase feldspars, progressively more ferroan and more sodic respectively, are strong indications of mineral fractionation in the Koraput suite. Chemical trends in the variation diagrams are compatible with feldspar fractionation in the Koraput suite. A weak Fe-enrichment trend in the early stage of differentiation, as observed in the AFM diagram, is compatible with that of the alkali-basalt series. Nb anomalies, both positive and negative, are indicative of crustal contamination as expected in synkinematic plutons. In terms of Gondwana assembly and break up, the alkaline complexes are supposed to represent rift-related magmatism along the continental margin. In spite of petrological evidence of the magmatic character of the Koraput Complex, anorogenic setting is contra-indicated by mesoscopic and microscopic fabrics, more akin to synkinematic intrusion during F_2 folding in the host country rocks. The Proterozoic alkaline complexes in the Eastern Ghats Belt, could alternatively trace the path of moving Gondwana continent over mantle plumes.

Key words: Synkinematic pluton, alkaline complex, Eastern Ghats, alkali-basalt series, mantle plume.

CORRESPONDENCE

C-isotope Composition of Carbonates from Indravati Basin, India: Implications for Regional Stratigraphic Correlation

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Abstract

The Indravati Basin represents an unmetamorphosed and unfossiliferous sequence and shows a broad similarity in lithological association with other Purana Basins of Central India. The carbonates belonging to Indravati Basin have on average, moderately positive $\delta^{13}\text{C}$ values (up to +4.5‰). Numerous successions reported from other parts of world, show similar $\delta^{13}\text{C}$ values and contain evidence to suggest that the latest Mesoproterozoic to early Neoproterozoic period may represent an isotopically recognizable interval globally. The elevated $\delta^{13}\text{C}$ values of Indravati Basin are also correlatable with other Purana Basins in India including Upper Vindhyan Supergroup.

Key words: Carbon isotopes, carbonates, Indravati Basin, Palaeoenvironment, correlation.

Run-up and Inundation Pattern Developed During the Indian Ocean Tsunami of December 26, 2004 Along the Coast of Tamilnadu (India)

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Abstract

The tsunami run-up, inundation and damage pattern observed along the coast of Tamilnadu (India) during the deadliest Indian Ocean tsunami of December 26, 2004 is documented in this paper. The tsunami caused severe damage and claimed many victims in the coastal areas of eleven countries, bordering the Indian Ocean. Along the coast of Indian mainland, the damage was caused by the tsunami only. Largest tsunami run-up and inundation was observed along the coast of Nagapattinam district and was about 10–12 m and 3.0 km, respectively. The measured inundation data were strongly scattered in direct relationship to the morphology of the seashore and the tsunami run-up. Lowest tsunami run-up and inundation was measured along the coast of Thanjavur, Puddukkotai and Ramnathpuram districts of Tamilnadu in the Palk Strait. The presence of shadow of Sri Lanka, the interferences of direct/receded waves with the reflected waves from Sri Lanka and Maldiv Islands and variation in the width of continental shelf were the main cause of large variation in tsunami run-up along the coast of Tamilnadu.

Key words: Indian Ocean tsunami, run-up and inundation, tsunami wave phenomenon, Tamilnadu, India.

CORRESPONDENCE

Ultra-high Excess Argon in Kyanites: Implications for Ultra-high Pressure Metamorphism in Northeast Japan

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Abstract

A laser fusion Ar-Ar technique applied on single crystals of kyanite from river sands of the Kitakami Mountain region of northeast Japan yielded ages of up to 16 Ga, more than three times the age of the earth. Although the age values are geologically meaningless, the ultra-high excess argon in kyanites is unique and hitherto unreported. We interpret this to be an artifact of ultra-high argon pressure derived from radiogenic argon in potassium-rich phases such as phengites during the Barrovian type retrogression of the ultra-high pressure rocks in this region.

Key words: Ultra-high excess argon, kyanite, Barrovian, UHP rocks, Ar-Ar age.