Crustal Evolution of SE Asia: A Perspective from Vietnam

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Southeast Asia consists of allochthonous continental blocks disintegrated from the northern margin of Gondwanaland. These include the South China, Indochina, Sibumasu and West Burma blocks, which amalgamated to form the SE Asian continent during Paleozoic to Mesozoic periods. The Song Ma belt characterized by the occurrence of metamorphic mafic and ultramafic masses of ophiolitic fragments represents the plate boundary between South China and Indochina blocks. Thus Vietnam is composed of two continental blocks, the part north of the Song Ma suture belongs to South China block and the part south of the suture belongs to Indochina block. Detailed geochemical and isotopic studies on basement rocks in northern and central Vietnam, which represent South China and Indochina blocks, respectively, have been conducted.

Differences exist for rocks from northern and central Vietnam. The gneisses of Cavinh Complex from N Vietnam have very low ε_{Nd} values (–43 to –29), Archean T_{DM} ages (3.4 to 3.1 Ga), 2.83 Ga U-Pb zircon upper-intercept age and 2.94 Ga SHRIMP U-Pb zircon age. These age data are the first evidence for the existence of a late Archean complex in N Vietnam and they are also the oldest age ever reported for the rocks in SE Asia. The Cavinh Complex represents the extenuation of Archean basement in the SW margin of South China block. On the contrary, Kannack and Song Ba Complexes, two alleged “Archean” rock units of Kontum massif in central Vietnam, define Proterozoic T_{DM} ages (2.4 to 1.2 Ga mostly, except one with 2.7 Ga) and medium ε_{Nd} values (–22 to –9). The Precambrian age of Kontum massif has been obtained in a zoned zircon core with a concordant age of 1.40 Ga using SHRIMP U-Pb dating in addition to some inherited ages of 2.5 to 2.7 Ga. Thus, the basement rocks from central Vietnam (Indochina block) are remarkably younger than that of N Vietnam (South China block).

The Precambrian crustal history of SE Asia is different for South China and Indochina blocks. South China block started crustal history in middle Archean and followed by late Archean, Mesoproterozoic and Neoproterozoic tectono-thermal events while Indochina block started in Late Archean and followed by Mesoproterozoic and Neoproterozoic tectonothermal events. In Phanerozoic, similar events of collision and extrusion orogenies - the Caledonian, Indosinian, Yanshanian and Himalayan - occurred in both blocks.

Compositional genomes: pre-RNA information transfer in mutually catalytic assemblies

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The origin of life is a fundamental open question. Textbooks often provide a mainstream view, asserting that life began with a specialized and rather complex molecule, e.g. RNA, capable of making its own copies. An alternative proposal maintains that self-replication can be manifested as an emergent property by a complex mixture of organic molecules catalyzing each other's synthesis in an intricate network of mutual interactions. Previous experimental studies, e.g. by Luisi and colleagues, demonstrated the autocatalytic formation of lipid vesicles or micelles. Combining such experimental evidence with a rigorous statistical chemistry approach, we have formulated the Graded Autocatalysis Replication Domain (GARD) model. It analyzes the kinetic behavior of small heterogeneous non-covalent assemblies of spontaneously aggregating molecules. The rate enhancement values for mutual catalysis are selected based on the statistical properties of molecular recognition in large molecular repertoires, as if life's origin constituted a planet-scale "random chemistry" experiment. In our computer simulations, assemblies grow and split due to the kinetically-enhanced recruitment of simple amphiphilic molecules, and to a free energy flux that keeps the system far from equilibrium. We show that such catalytically successful idiosyncratic molecular compositions get selected and propagated, leading to the emergence of a rudimentary form of inheritance - a "compositional genome". To our knowledge, this "lipid world" scensario is the first quantitative kinetic description of information transfer in a system devoid of biopolymers. This research may help understand how natural selection could have emerged prior to an RNA sequence-based genetic apparatus.