CENTRAL ASIA – A KEY AREA FOR UNDERSTANDING PLATE TECTONIC PROCESSES

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Central Asia comprised of Mongolia and adjacent eastern and southern regions is a key area for understanding not only open regional but also open theoretical questions of geodynamics as is demonstrated by the presence of many folded systems, a complex system of terranes and tectonic units and a unique suite of huge quantities of often multiphased in many cases Mesozoic intraplate magmatites of the Mongol-Oghotsk Belt (stretching from Mongolia to the Pacific).

Thus on the one hand a wealth of regional information that accumulated in the last decades through various large long-term projects exists. This includes results of large and long-range joint Russian-Mongolian studies as well as a multidisciplinary geotraverse within the International Lithosphere Program. As a result of these initiatives, concepts about the paleozoic plate tectonic history (with some solvable open questions) exist. The mesozoic plate tectonic history, especially the causes of the implacement of vast amonts of granitic and granitoitic melts (and the quantitative understanding of causes and processes) is however still not beyond a descriptive state (which includes trace element studies, isotope geochemistry and an increasing number of isotope datings).

The paleozoic tectonic history, which is characterized by the accretion of various microcontinents and terranes can be (highly simplified) summarized as follows (see for overviews including syntheses, solved and open questions for example Kovalenko et al. 1995, Zorin et al. 1993 and Zonenshain et al. 1990): During early Cambrian and Late Ordovician times the "Tuva Mongolian Microcontinent" (and surrounding island arc systems) moved northward and collided with the "Siberian Platform". Subsequent rotation during devonian times closed the western edge of the "Mongol Okhotsk Ocean" followed by a northward dipping subduction zone at the northern edge of Paleothethys (= at the southern edge of the "South Mongolian Microcontinent"). Above lines are highly condensed and contain many ommissions and simplifications. They do in addition not discuss open questions for example in connection with necessary further paleomagnetic data. It is however possible to conclude that at late paleozoic / early mesoic times Mongolia consisted of various accreted terranes. It is also possible to state that further accretion (where applicable) continued further south resulting (in the widest sense) in the Cenozoic Indian/Asian collision several thousand kilometers further south. These lines are, with respect to geodynamic concepts nothing new. Any arising questions in this area can be solved by known techniques including laboratory, GIS (for the easier handling of opposing concepts) and field techniques.

In this context it is however a striking feature that although major plate tectonic processes operated considerably further south of Mongolia (and in respective areas further east) during mesozoic times huge amounts of granites/granitoids that cover in large areas a major fraction of the geological map have been formed. Thus any concept that might call for a "modificated back arc process" cannot solve this question. In addition the large extension in E-W direction raises, if they are interpreted as trace of a hot spot (highly simplified: the eurasian plate moving over a hot-spot located in Mongolia) raise questions of mass-bilances.

Although above statement is simple it has wide implications:

1) Trace element and isopte geochemical studies show that (for granites where data exist) their origin is of continental nature.
2) If however such large amounts of magmas ascend this must, as a simple consequence of "fluid" mechanics and mass movements, affect large parts of the middle and (where applicable) lower crust / mantle.
3) In other words: Assuming a convection model and considering the known mesozoic plate movements (Atlantic, Polar Sea, Indian Ocean, Pacific) the question arises: "How did the convection beneath the large (and thus misunderstandably unspectacular) Siberia look like? And: Why did it change such (and how) that the granites formed? This is especially important because (also for reasons of "fluid" mechanics) long-term subduction over hundreds of million years (from early Cambrian on) at the northern margin of paleotethys ("Oceans south of Siberia and accreted terranes in the widest sense") and the western Pacific needs to be described also with respect to "induced" particle movements (integrated effects over respective long times).
4) Granites do not form at the surface. This means that in this case on a wide belt of several thousand kilometers length several thousand meters of sediment have been subsequentely removed (in late mesozoic and cenozoic times) implying (a) a respective uplift (and another mass movement/displacement) and of course (b) respective erosion, deposition (where?) and subsidence in Cenozoic times.
5) The study of timing of these events including the deduction of respective depths are standard geological techniques.
6) Given the right mineralogical composition (phase diagrams), water content and depth it is however possible that minor changes of the stress field may move equilibria from solid to liquid. If in this context (for all or some of the granites) the "implacement" of the granites occurred factually without mass movement then the question of the boundary conditions focuses mainly on the thermal field in connection with stress field analyses (and respective mineralogical studies).
7) Multiphase intrusions can however only be regarded as understood if the pacing boundary conditions are known (including the implications for the surroundings) or (which is quantitatively possible) the phases can be simulated with the help of set of self-organizng equations describing the cooling, cristallization and subsequent shift of points in the phase diagrams. Such equation systems are able to produce cycles from *within* the system.

Above sentences and questions describe boundary conditions. The core question however is the state of the convection-system beneath Siberia through late Paleozoic and Mesoic times. This can be regarded as understood if, together with the boundary conditions set by the known plate–movements (Indian Ocean, Pacific, Arctic Ocean) a late paleozoic data-set might autonomously generate the early Cenozoic situation (formulated as an ambitious but achievable goal).

The quantitative simulation of convection systems has during the past decade been addressed from many institutions. One powerful system that is suitable to (a) handle "fluid" flow, (b) handle rigid deformation and (c) is able to integrate geological boundary conditions is the system "fastflow" that is developed by CSIRO/Sydney.

Above questions can neither be solved by "pure modeling" (as input conditions and milestones against which the modeled results are compared at the various time-steps are needed) nor can they be solved by "pure fieldwork" (including trace element studies, dating and GIS). The reasons are (a) the complexity of the question, which, if approached from the modeling side requires additional background data from Central Siberia, the West Pacific margin, central Tibet and (potentially) the Arctic Ocean and (b) the fact that larger parts of the crust are unaccessible even if funding would be no question.

What however *is* possible is the stepwise integration of a wealth of existing data, modeling, well focused isotope dating of multiphase intrusions at key sites with for example Zr single grain dating (reflecting potentially more than one thermal event in one grain), well focused *supplementary* geochemical studies and palinspastic reconstuctions both along transects and in time-intervals. In the past for the solution of such questions one large institute with a large budget was needed, especially as necessary routine works (laboratory, mapping, drawing etc.) needed shere manpower. The 21st century is, compared to the last decades of the past century characterized by small size high-efficiency technology (not only in computing), small (if any) administrative structures and, in this context, high-efficiency well optimized (= streamlined) budgets encouraging thinking in terms of solutions and not in terms of sizes of institutes / working groups / formal structures. Now in the 21st century those properties that needed manpower in the past are, also in science, in many cases available as "desktop technology" and are thus a question of the usage of streamlined budgets through optimized coordination.
In other words: What is needed is a research network of people who want to solve above questions The necessary field and laboratory work can be done, if a common focus from several institutes to solve these (and related) questions exists within a set of M.Sc., PhD and Post-Doc studies. These can be arranged such that each one contributes to respective sub-questions (open communications also regarding the mid- and long-range strategies of the participating research groups is now no problem any more). Whether a European (or American) PhD works in central Australia or central Asia: The budget is available (otherwise he or she would not be able to do this work) and the costs are comparable. The necessary information flow does even not require a series of expensive meetings, but can be achieved easily through the internet as the existing technology that is available factually worldwide permits the synchronous working on maps, open questions and model results even (when necessary) in the form of online discussions.

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