

Report on
IGCP-476 Fifth International Symposium and Workshop
“Monsoon Evolution and Tectonics and climate linkage in Asia”

at Koshiba Hall, Graduate School of Science, University of Tokyo

From December 6th to 8th, 2007

1. Workshop

Workshop was held in the afternoon of December 6th before the symposium. The workshop begins with reports on the present status of IODP projects related to IGCP-476. **Nobu Eguchi** of CDEX, JAMSTEC reported recent operation of Japanese drilling ship Chikyu off Honshu. **Won Soh** of Kochi Core Center, JAMSTEC reported the possibility of near future scheduling of Asian Monsoon-related proposal (possibly the Sea of Japan and northern East China Sea drilling) in 2009. He also reported that IODP decided to organize Detailed Planning Group (DPG) on Asian monsoon, which will discuss and develop overarching goal of monsoon related drilling proposals in Asian continental margin area and strategy to attain such a goal. He further reported present budgetary situation of IODP. In the later half of the workshop, **Hongbo Zheng** of Tongji University introduced the plan for the next phase of IGCP project that will be built on the achievement of IGCP-476 but will extend to new dimension with new concepts. He proposed “Evolution of river system in Asia” as a new target and suggested associated topics such as i) its relation with Himalaya-Tibetan Plateau uplift, ii) relevance to global carbon cycle (through controlling chemical weathering and organic carbon burial), iii) role of monsoon on its evolution, and iv) its impact on paleoceanography of marginal seas. Discussion follows after his presentation. We (participants) agreed to focus on “Evolution of river system in Asia”. We also generally agreed that it is important to maintain the scientific community brought up through IGCP-476, but also realized the necessity to incorporate new community. We also discussed potential title of the new project and “Evolving Asian River System: Processes, controls, and impacts” is selected as a candidate, although there was an opinion that clearer key word for paleoceanographic community may be necessary. Based on the discussion, Hongbo Zheng will write up a proposal draft of the new project by early next year and circulate among the members of IGCP-476. Members will give him feedbacks with which he will finalize the draft and submit to IGCP by next deadline.

2. Symposium

Fifth (and final) international symposium of IGCP-476 “Monsoon Evolution and Tectonics-Climate Linkage in Asia” was held at Koshiba Hall, Graduate School of Science, University of Tokyo. Eleven talks including four keynote talks and seventeen posters were

presented in the symposium. Oral presentations were carefully selected so as to synthesize the five years' accomplishments of IGCP-476. One invited talk (Quade) was cancelled at the last moment due to the unexpected accident.

The symposium is composed of three sessions. Session 1 is "Monsoon evolution", session 2 is "Tectonic evolution and erosional history of the Himalaya-Tibetan Plateau", and session 3 is "Tectonics-climate linkages, perspective from climatic simulations".

In session 1, **Guo** introduced 22 M.y. loess record in western Chinese Loess Plateau. He suggested the possibility of major climatic reorganization at Oligocene/Miocene boundary and potential role of the closure of Paratethys on that change. He also suggested temporal increase in loess accumulation rate at 15, and 8 Ma and drastic and irreversible increase since 3.7 Ma.

Tada summarized provenance changes of eolian dust supplied to Chinese Loess Plateau during the last 7 Ma. He introduced new provenance tracing method utilizing ESR signal intensity and crystallinity index of quartz and demonstrated Taklimakan desert became a major dust source since 4.3 Ma. He also suggested possible linkage between the uplift and erosion of Kunlun Mountains and increasing dust emission from the Taklimakan desert. **Clemens** reviewed long term proxy records of Indo-Asian monsoon covering the last several million years, and examined temporal evolution of their phase relationships with $d^{18}O$ of foraminifera and the northern hemisphere insolation changes in obliquity and precession bands which are inferred assuming northern hemisphere insolation forcing of the ice volume changes. He found unusually large phase lag of monsoon proxies examined before 2.75 Ma, of which inconsistencies can be solved if assuming southern hemisphere insolation forcing of the ice volume changes in precession band and suggested revision of $d^{18}O$ timescale before 2.75 Ma.

Chen reviewed marine records of East Asian monsoon variability during the last 10 m.y. First evidence of the increase in summer monsoon induced upwelling is found at ca. 8 Ma in the South China Sea, further increase in upwelling from 3.6 to 2.6 Ma, and establishment of western Pacific warm pool at 1.7 Ma. He also mentioned the increase in terrestrial organic matter input at 440 ka (MIS 12) which could be related to intensification of summer monsoon. **Shinha** reviewed evolution of Indian monsoon based on terrestrial records. Based on $d^{18}O$ and $d^{13}C$ of pedogenic carbonate, $d^{13}C$ of organic matter, dD of pedogenic clay, and changes in sedimentation patterns, he demonstrated intensification of summer monsoon at 10.5 Ma and 5.5 Ma, and establishment humid climate in Siwalik basin by 6 to 5.5 Ma. This humid climate lasted till 2.6 Ma and drier and cooler climate prevailed afterward. He also described shorter time-scale changes during the Quaternary period.

Session 2 is Tectonic evolution and erosional history of Himalaya-Tibetan Plateau. **Sakai** presented a synthesis of the work by his group on extrusion of Himalayan metamorphic nappe. Based on their thermo-chronological studies, he demonstrated metamorphic nappe of 10 km in

thickness started its extrusion by 14.4 Ma (minimum age), nappe reached southern Himalaya and stopped by 10 Ma, the latter coincides with onset of MBT activity. The nappe cooled and became brittle by 2 Ma, when MFT activated. He demonstrated that the nappe has a width of at least 800 km and length of at least 100 km. **Zheng** introduced the on-going research result on the continuous terrestrial sedimentary sequence spanning from late Eocene to Pleistocene exposed on the northern foot of western Kunlun Mountains. He demonstrated the evidence of tectonic uplift and erosion of the western Kunlun Mountains started from 4.6 Ma and intensified at 3.6 Ma. He also demonstrated the evidence of desertification of the Tarim basin approximately at 8 Ma and also after 4.6 Ma. He stressed the high probability that the sequence preserve the continuous records of both tectonics and climate evolution in the back side of Tibetan Plateau during the last 35 Ma. **Clift** pointed out the discrepancy in timing between intensification of Indian monsoon at 8Ma and increase in sediment accumulation rate in Indus fan approximately at 23 Ma. He examined provenance changes of Indus river sediments using Nd-isotope and demonstrated significant changes in provenance between glacial and interglacial periods. He interpreted this change as reflecting summer monsoon precipitation pattern changes between glacial and interglacial periods and stressed the importance of monsoon precipitation on enhancing erosion and exhumation, not only for shorter time-scale but also for longer time-scale. **Huh** talked about CO₂ sink potential of the Indo-Tibetan Collision Zone. She demonstrated that chemical weathering of silicate minerals (inorganic subcycle) is the major control of atmospheric CO₂ although organic carbon oxidation also plays similarly important role in some rivers. Based on her extensive data set of dissolved load of Asian rivers, she estimated net CO₂ consumption rates for each river. She demonstrated that net CO₂ consumption rates of Himalayan rivers are generally high. She also evaluated controlling factors of chemical weathering yield, among which chemical weathering yield is more or less proportional to the runoff and increases with the increase in physical weathering rate. Thus, it now becomes possible to evaluate net CO₂ consumption potential of the Himalaya-Tibetan rivers.

Session 3 is Tectonics-climate linkages, perspective from climatic simulations. **Kitoh** introduced his simulation results on the effect of topographic uplift on monsoon evolution. In his simulation, he increased heights of world mountains from 0% (no mountain case) to 100% (full mountain case) by every 10% and examined climatic changes caused by the uplift. He demonstrated that important climatic changes such as westerly jet path changes, emergence of Baiu front, and decrease in SST due to intensified upwelling off north Arabian Sea occurred when mountain heights reach 60% of the present values. He also mentioned briefly about resolution issue and speculated that higher resolution (120 km or 60 km grid) simulation with AO-GCM will become available within several years. **Motoi** introduced his simulation result

of closure of Panama gateway on East Asian winter monsoon. He demonstrated that opening of the gateway intensifies Kuroshio Current and enhances production of North Pacific Intermediate Water. Whereas closure of the gateway results in enhanced stratification in North Pacific, sea ice formation, decrease in SST, and development of high pressure anomaly over Bering Sea. This in turn is expected to decrease East Asian monsoon intensity and changes in direction toward more W-E direction.

At the end of the symposium, we had general discussion. In order to enhance interaction among paleo-climate, tectonics, and modeling communities, we asked each community to list up information that it wants from other two communities. Paleo-climate community was asked to provide more quantitative, higher resolution, and spatial data set of key areas during key time intervals. Tectonic community was asked to provide clearer vision on the mode or process as well as timing of uplift of Himalaya and Tibetan Plateau. Climate modeling community was asked to incorporate geographic effect such as high mountain chains in the model. In addition, evaluation of the influence of other tectonic events such as presence of Paleo-Tethys, closure of Panama gateway, and Indonesian gateway, was considered as important.

As a result of this symposium, it became clearer that there seems to be a few key time intervals. First is 22-15 Ma that covers onset of nappe extrusion in frontal Himalaya and establishment of East Asian monsoon climate in East Asia. Second is 10-8 Ma that covers establishment of Great Lesser Himalaya and intensification of Asian summer monsoon. Third is 5-3.5 Ma that covers uplift of the Kunlun and Tian Shan mountains, formation of the Taklimakan desert, and further intensification of East Asian summer monsoon. Forth is 2-1 Ma that covers activation of the Main Frontal Thrust, further uplift of Kunlun and Tian Shan mountains, and further intensification of East Asian winter monsoon. It is suggested that the future project should focus on these four time intervals to explore tectonics-climate linkages for individual cases.

3. Poster Session

Poster session was held in the afternoon of December 7th. Seventeen posters were presented. During the afternoon of December 7th, two minutes introduction of the posters were given. Then poster session started and continued for over two hours. Posters were displayed during the rest of the symposium and intensive discussion continued during coffee breaks.

4. Synthesis Volume

A synthesis volume are planned to be published from Geological Society of London in the

form of GSL special publication. Tada made a contact with GSL on October and still waiting for their final decision. If our synthesis volume proposal to GSL will be rejected, we will publish a synthesis volume either in *Island Arc* or *Sedimentary Geology*.

5. Next Meeting

Because this is the last year of IGCP-476, there will be no meeting supported by IGCP next year. However, since Zheng is planning to submit a new project proposal next October, participants were encouraged to participate in 6th International Conference on Asian Marine Geology that will be held from August 29th to September 1st of 2008 in Kochi, Japan, in which we will organize a session “Asian monsoon: land-ocean and tectonic-climate linkages”.

6. Participants

In total, 54 people from 7 countries including Japan (41), Korea(4), China(4) (including Taiwan(2)) , India(2), USA(1), UK(1), and Austria(1) participated in the symposium and workshop. The participants include 16 graduate students from 5 universities that include 2 universities from Taiwan and Korea.. A Participants List is attached in this document Group photo was taken in front of Science Building #1 of University of Tokyo, and also attached in this document.

7. Financial Supports

The symposium and workshop were supported by IGCP, J-DESC, and 21 COE program of Department of Earth and Planetary Science, University of Tokyo. The fund of 500,000 yen provided by J-DESC was used for travel and accommodation supports for invited speakers, printing of abstract volume, and payments for part time work by students who helped preparation, organization, and operation of the workshop and symposium. Detail of the account is shown in the table below. Small amount of money (33739 yen) was left partly because of the last minutes' cancellation of one speaker.

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