PROJECT FICHE

Bilateral Cooperation
Bilateral Agreement with China
Projectcode BL/36/C62

The Cretaceous Greenhouse World and its impact on terrestrial ecosystems in Asia

Project title : The Cretaceous Greenhouse World and its impact on terrestrial ecosystems in Asia

(Geographic) study area: Northeastern China and adjacent areas (Transbaikalia)

OSTC testsite (if applicable) **:**

Context and objectives

Climatic ("Cretaceous Greenhouse World") and palaeogeographic changes during the Cretaceous in NE China and their impact on the evolution of terrestrial ecosystems are investigated in this project. Disentangling these interactions requires the study of three geological units: the Jehol Group in Liaoning Province (~ - 140 to - 110 My ago), the Quantou Formation in Jilin Province (~ - 110 to - 90 My ago), and the Yuliangze Formation in Heilongjiang Province (~ -70 to – 65 My ago). These three formations have already yielded exceptionally abundant and diversified palaeofloras and palaeofaunas, cover an important part of the Cretaceous, and are located not far from the Beringian land bridge between Asia and America.

During the course of this project, we have discovered exquisitely-preserved fossils of primitive birds and feathers dinosaurs in Liaoning Province, but also in Transbaikalia (southeastern Siberia). These discoveries are therefore a unique opportunity to better understand the early diversification of birds, during the Middle-Late Jurassic and the evolution of feathers and plumage in dinosaurs.

Methodology

WP1: New excavations in Late Jurassic and Cretaceous fossil localities from NE China and adjacent areas.
WP2: Reconstructing the evolution of palaeotemperatures during the Cretaceous through investigation of high resolution stable isotope and trace element profiles using mass spectrometric techniques.
WP3: Reconstructing the evolution of climate during the Late Cretaceous through the study of the morphological characteristics of angiosperm leaves.
WP4: Dating and reconstructing the palaeoenvironment of the Cretaceous formations in NE China.
WP5: Evolution of the vegetation of NE China during the Cretaceous.
WP6: Evolution of the biodiversity of vertebrate faunas in NE China during the Cretaceous.
WP7: New perspectives for studying soft tissues of "feathered dinosaurs" from the Yixian Formation of Liaoning Province.

Results

WP1:
- Excavations in the Quantou Formation (Cenomanian, early Late Cretaceous) of Liufangzi (Jilin Province).
- Prospections and excavations in the Tiaojoshan and Yixian Formations of Liaoning Province.
- Excavations in the Jurassic Ukureykaya Formation of Transbaikalia.

WP2:
- Sampling vertebrate teeth in the Tiajishan, Yixian, Quantou, Yuliangze and Ukureiskaya formations of N-E China and Transbakalia for Stable Isotope Analyses (∂18O, ∂13C, ∂15N) of fossil phosphatic material, using the new Nu Perspective mass spectrometer installed at the VUB (Hercules project). Analyses will start at the end of 2014.

WP4:
- New radiometric dating and reconstruction of the palaeoenvironment for the Tiaojishan and Yishian formations of Liaoning Province.

- Radiometric dating and palaeoenvironmental reconstruction of the Late Jurassic Ukureyskaya Formation of Transbaikalia.

WP5:

- Inventory and reconstruction of the palaeoflora in the Tiaojishan Formation of Liaoning Province.

WP6:

- Description of a new basal ornithomimosaur (Dinosauria: Theropoda) from the Early Cretaceous Yixian Formation (Liaoning Province). New phylogeny of ornithomimosaurs.
- Anatomy and relationships of *Bolong yixianensis*, an Early Cretaceous iguanodontoid from western Liaoning Province.
- Description and phylogenetic relationships of a new Enantiornithine bird with spectacular, hyper-elongated feathers from the Early Cretaceous of western Liaoning Province.
- Description of a new Jurassic paravian theropod with reduced plumage and flight ability from the Jehol Group of Liaoning Province.
- A new avialan dinosaur from the Tiaojishan Formation of Liaoning Province resolves the early phylogenetic history of birds.
- Description and phylogenetic affinities of a new long-tailed basal birds from the Early Cretaceous Yixian Formation of Liaoning Province.
- A new Jurassic ornithischian dinosaur from Transbaikalia with feathers and scales suggests that all dinosaurs were potentially covered with protofeather-like integumentary features.

WP7:

- Eumelanin pigment is preserved in a feathered avalian dinosaur from the Late Jurassic of Liaoning Province.
- Genetic mechanisms limiting the growth of long epidermal structures on the distal portion of the hindlimb and on the tail likely existed within the whole dinosaur clade, facilitating bipedal terrestrial locomotion.

Products and services (if applicable: maps, database, peer reviewed article(s),weblink..

Peer-reviewed papers

1. Godefroit, P., Lauters, P., Van Itterbeeck, J., Bolotsky, Y.L., Dong, Z.-M., Jin, L.-Y., Wu, W., Bolotsky, I., Y., Hai, S. & Yu, T., 2012. Recent advances on the study of hadrosaurids dinosaurs in Heilongjiang (Amur) River area between China and Russia. *Global Geology*, **14 (3)**: 160-191.
2. Jin, L., Chen, J. & Godefroit, P., 2012. A new basal ornithomimosaur (Dinosauria: Theropoda) from the Early Cretaceous Yixian Formation, NW China. *In*: Godefroit, P. (editor), *Bernissart Dinosaurs and Early Cretaceous Ecosystems*. Indiana University Press, Bloomington and Indianapolis, pp.
3. Wu, W. & Godefroit, P., 2012. Anatomy and relationships of *Bolong yixianensis*, an Early Cretaceous iguanodontoid dinosaur from western Liaoning, China. *In*: Godefroit, P. (editor), *Bernissart Dinosaurs and Early Cretaceous Ecosystems*. Indiana University Press, Bloomington and Indianapolis, pp. 311-352.
4. Godefroit, P., Demuynck, H., Dyke, G., Hu, D-Y., Escuillié, F., Cau, A. & Claeys, P., 2013. Reduced plumage and flight ability of a new Jurassic paravian theropod from China. *Nature Communications*, **4**:1394 doi: 10.1038/ncomms2389. **IF_{2013}= 10,742.**
5. Godefroit, P., Cau, A., Hu, D.Y., Escuillié, F., Wu, W., & Dyke, G., 2013. A Jurassic avialan dinosaur from China resolves the early phylogenetic history of birds. *Nature*, 498: 359-362. **IF_{2013}= 42,351.**
6. Godefroit, P., Sinitsa, S., Dhouailly, D., Bolotsky, Y.L., Sizov, A, Mc Namara, M.E., Benton, M.J., & Spagna, P., 2014. A Jurassic ornithischian dinosaur from Siberia with both feathers and scales. *Science*, **345**: 451-455. **IF_{2013}= 31,477.**
7. Godefroit, P., Sinitsa, S., Dhouailly, D., Bolotsky, Y.L., Sizov, A., Mc Namara, M.E., Benton, M.J. & Spagna, P. 2014. Response to Comment on "A Jurassic ornithischian dinosaur from Siberia with both feathers and scales". *Science*, in press. **IF_{2013}= 31,477.**
8. Lefèvre U., Hu D.-Y., Escuillié F., Dyke G. & Godefroit P**.**, 2014. A new long-tailed basal bird from the Early Cretaceous of northeastern China. *Biological Journal of the Linnean Society*, **113**: 790-804. **IF_{2013}= 2,535**.
9. Atterholt, J., Dyke, G., Hu, D.-Y., Escuillié, F. & Godefroit, P. A new Chinese enantiornithine bird with spectacular hyper-elongated feathers. *PLoS ONE*, in revision. **IF $_{2013}$= 3,354.**

Master and PhD theses

Ulysse Lefèvre, 2012-2013. *Une nouvelle espèce de Jeholornis (Dinosauria, Avialae) du Crétacé inférieur de Chine - révision systématique et phylogénétique des Jeholornithiformes*. Master thesis (U. Liège, Biology; Promotor, E. Poty; Co-Promotor, P. Godefroit).

Ulysse Lefèvre, 2013- . *Jurassic feathered dinosaurs from Asia and the early evolution of feathers*. Ph D thesis (U. Liège, Geology; Promotor, E. Javaux; Co-Promotor, P. Godefroit).

Aude Cincotta, 2013- . *Paleo-environmental reconstruction of Konservat-Lagerstätten and characterization of their preservation modes, linked to exceptional fossilization of soft tissues.* Ph D thesis (U. Namur, Geology; Promotor, J. Yans; Co-Promotor, P. Godefroit).

---------- Ideas for future research----------
Jurassic dinosaurs from north-eastern China and Transbaikalia: the origin of feathers, plumage and avalian flight

Execution

Period: 2012/04/01 –2014/04/30
Laboratory/network (promotor names, institutes, mail-adresses, web-site) :

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International partners:

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Discipline (select one or more appropriate disciplines)

Palaeontology