

## **IGCP 317: Paleoweathering Records and Paleosurfaces**

Quentin Gall

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[Aller au sommaire du numéro](#)

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# Conference Reports



## IGCP 317: Paleoweathering Records and Paleosurfaces

Quentin Gall  
Department of Earth Sciences  
Carleton University  
Ottawa, Ontario K1S 5B6

The new International Geological Correlation Programme (IGCP) project 317, Paleoweathering Records and Paleosurfaces, is intended to bring together geoscientists interested in such topics as continental paleolandscapes, the correlation of azoic continental deposits, records of global change, and the economic potential of regoliths. The first meeting of IGCP 317 took place at the École des Mines de Paris in Fontainebleau, France, from November 25 to 29, 1991. The project leaders, Médard Thiry (France) and Jean-Michel Schmitt (France), were also the meeting's hosts. Some 30 geoscientists from 13 countries attended this first meeting.

The first three days of the meeting were devoted to a workshop on silcretes led by M. Thiry and A.R. Milne (Australia). Thematic oral presentations were given during the first morning by the workshop leaders, M.J. McFarlane (England), V. Rayot and R. Simon-Coinçon (France). These presentations focussed on the mineralogy and geochemistry of silica in paleoweathered Tertiary landscapes of South Australia. M. Oujidi (Morocco) also presented a study of the chertification of Triassic-Jurassic limestone in eastern Morocco.

Thiry and Milne gave short lectures describing pedogenic and groundwater silcretes from both the Paris Basin and the opal

mining region of South Australia. Between lectures, there was time to inspect hand samples and thin sections from representative specimens. Both regions show similarities with respect to silicification of the Tertiary sedimentary units. These similarities include: 1) a variety of quartz types, 2) the ubiquity of kaolinite, 3) the presence of pedogenic silcrete profiles complete with vertical dissolution features and titaniferous illuviation structures, and 4) the location of pedogenic silcretes along the basin margins and/or at higher topographic elevations compared to the more massive groundwater silcretes.

On the third day, participants were taken on a field excursion to several sites on the Brie and Beauce plateaus of the Paris Basin. Different types of silicification in sedimentary rocks were observed. The first stop took us to see limestone of the Upper Eocene Champigny Formation, which exhibits metre-scale concordant zones of laminar silicification ascending into more massive silicification, and then into a discordant silicified zone with solution pipes. Silicification is considered to have resulted from groundwater movement after burial of the limestone by the quartz-rich Fontainebleau sands (Oligocene). Next, we visited an abandoned quarry near Montigny-Leucoup on the edge of the Paris Basin, where pedogenic silcrete was developed along with kaolinite in sandy clay of the Lower Eocene Argiles Plastique Formation. This pedogenic silcrete profile exhibits characteristic vertical morphological zonation from basal granular, to massive, to columnar, to a topmost nodular zone. Kaolinite, opal, microcrystalline quartz, anatase and illuviation structures are common. The final stop of the day was at the Oligocene Fontainebleau sands in an active quarry where the quartz sand is being used for glass manufacturing. Exposed within the quarry are three silica-cemented stratiform zones within otherwise uncemented sands. These silicified zones are considered to be groundwater silcretes developed during progressive lowering of the water table. Locally, silicification appears to have followed burrows within the beach-facies sands.

The last two days of the meeting were devoted to presentations on the general theme of mineralogical and geochemical

records of paleoweathering. This portion of the conference began with an invited lecture by M. Pagel (France) on the use of U, Th and REE geochemistry in paleoweathering profiles. He discussed mass balance calculations through normalization to Th, an attempt to use U-Th isotope systematics to date paleoweathering, and REE behaviour during laterization. These were frequently related to the paleoweathering and unconformity-type uranium mineralization in Saskatchewan. Subsequent presentations on this day described Tertiary and Mesozoic paleoweathering. Presentations included paleosurface morphologies in Morocco (Ben Brahim, Morocco), the paleoenvironmental significance of ferricretes (Fedoroff *et al.*, France), lateritization and placer gold in Burkino Faso (Sanfo *et al.*, Burkino Faso), karst development and subsequent sedimentary infilling near Quercy, France (Simon-Coinçon and Astruc, France) and a discussion of Appalachian saprolites (Pavich, United States). An unusual example of albitization resulting from Triassic paleoweathering of the Massif Central was described by Schmitt (France). The day ended with a presentation by Stoops (Belgium), on a study which used micromorphological features to distinguish alternating paleoweathered and unweathered zones encountered in drill core in the Brabant Massif of Belgium.

Presentations during the final day of the meeting described Paleozoic and Precambrian paleoweathering. These presentations began with a description of kaolinite- and quartz-rich paleoweathering profiles developed in granite and gneiss of the Precambrian Hoggar Shield beneath the Paleozoic Tin-Seririne Basin, Algeria (Esteoule-Choux and Halloulouche, France and Algeria). An overview of Precambrian paleosols in Canada was then presented (Gall, Canada), which included discussion of the diagenetic overprinting of paleosols and the problems in identifying metamorphosed paleosols. This was followed by another presentation by Pagel (France) on the role of lateritization and paleogeomorphology in preconcentrating uranium prior to the development of unconformity-type deposits in Saskatchewan. A description of the Thelon paleosol in the Northwest Territories (ca. 1740 Ma) was then presented (Gall, Canada). During this pre-

sentation, it was theorized that, based on paleosol features, geochronology and gross stratigraphy, the Thelon paleosol likely developed during the same paleoweathering event as the Athabasca paleosol (described by Pagel), and the Hornby Bay and Elu Inlet paleosols. Together, these paleosols represent remnants of a widespread Proterozoic paleoweathering surface, now preserved as the Matonabee unconformity. The final presentation (Zalba, Argentina) described Upper Proterozoic and lower Paleozoic paleoweathering records and paleosurfaces within the Tandilia system, Buenos Aires province. The day was concluded by a business meeting.

The first meeting of IGCP 317 was successful in bringing together geoscientists from many countries who have a common interest, thus permitting extensive personal interaction. Geomorphologists, pedologists, and geologists were able to meet, and discover what aspects of paleoweathering were considered important to other geoscientific groups, and what analytical techniques each group used. It became clearer, for example, that some presentations described "deep" paleoweathering in older rocks, relying extensively on mineralogical and geochemical signatures for their interpretation. However, in younger examples of paleoweathering, the more prevalent signatures of paleoweathering appear to be morphological features, soil horizonation, and organically formed structures. Whether the differences are a function of erosion level, biologic influence, or the influence of other soil-forming factors such as climate remains a challenging question. It also became clear that the extent of diagenetic overprinting of paleosols has not been realized and must be assessed, especially when studying Tertiary paleoweathering.

Papers based on the presentations at the meeting will be published in August 1992 in a special issue of the Earth Science series of the *École des Mines de Paris*. As well, IGCP 317 participants are currently working toward a worldwide inventory of paleoweathering records. It is hoped that much of the inventory will be complete for the second annual meeting of IGCP 317, to be held in conjunction with the Cuarta Reunion Argentina de Sedimentología in La Plata, Argentina, between 5-9 October 1992.

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## Palliser Triangle Global Change Observatory Workshop

D.S. Lemmen  
*Geological Survey of Canada*  
3303 – 33rd Street NW  
Calgary, Alberta T2L 2A7

R.J. Fulton  
*Geological Survey of Canada*  
601 Booth Street  
Ottawa, Ontario K1A 0E8

The papers of Captain John Palliser's 1857-1860 expedition eloquently describe the climatic sensitivity of the "dry prairies" of southern Manitoba, Saskatchewan and Alberta, which have become known as the Palliser Triangle (Spry, 1968). While Palliser could not foresee the critical agricultural importance this region would assume, he was aware of the harsh reality of drought. Understanding of past drought cycles is critically important to proper land management in this region, including the formulation of land use proposals under climatic change scenarios.

The Geological Survey of Canada (GSC) is establishing a Global Change Observatory in the Palliser Triangle. The historical climate record for this region generally encompasses less than 100 years, and needs to be placed within a geologic timeframe to better understand "natural" drought intensity and periodicity. By outlining the rates of geomorphic processes and the manner in which these rates have varied in the past with changing climate, it will be possible to provide meaningful assistance to future land-management. As such, the two main objectives of this project are: 1) to obtain a high resolution record of paleoclimatic change from lake basins within the region, with particular emphasis on the last 2000 years; and 2) to correlate contemporary and paleo-process data with (paleo)climate to ascertain past and present rates of geomorphic processes as influenced by climate.

The project will employ a co-operative multi-disciplinary approach involving both government and university researchers. In an effort to obtain input from individuals actively involved with, or interested in, climatic

aspects of the geoscience record in the Palliser Triangle, the GSC held an organizing workshop in Calgary on 16-17 November 1991. Thirty-seven participants attended representing six federal, five provincial and fourteen university departments.

The first day of the workshop consisted of invited talks focussed upon the main objectives of the project. Four talks (John Smol, diatoms; Denis Delorme, ostracodes; Bob Vance, palynology; Bill Last, mineral sediments) dealt with aspects of the lacustrine record. Although certain limitations will be encountered owing to the unusual lacustrine environment of the region, it was clear from Vance's study of Chappice Lake that a useful paleoclimatic record can be developed by utilizing a variety of proxy data and dating by accelerator mass spectrometry (AMS). Tom Edwards reviewed the use of stable isotopes in paleoclimatic studies, emphasizing that isotopes provide a more direct climate signal than other proxy sources. Eric Neilson reported on the potential of dendrochronology from sites marginal to the Triangle as a means of obtaining a continuous paleoclimatic record. Dave Sauchyn emphasized a spatial perspective with regard to studying geomorphic processes, noting that practical applications of this project are dependent upon an ability to extrapolate site-specific data to a regional perspective. Willem Vreeken focussed upon the temporal variability of geomorphic processes in the Palliser Triangle as evidenced by a complex record of paleosols and inferred paleoprocesses.

On the second day of the workshop, participants convened in two groups, one to discuss the limnological aspects of the project and the other to discuss the terrestrial component. The limnological group discussed specific matters such as site selection, coring, sampling and analysis. The terrestrial group involved persons from a wide range of interests and, hence, their discussions were more general. There was agreement that the Cypress Hills are the hub of the Palliser Triangle, and that study sites should be located along radiating transects extending from the hub to the periphery of the Triangle. It was recognized that sites must represent both the pre- and post-settlement landscape, and be viewed in the context of open and closed geomorphic systems.

Numerous matters were raised during discussion sessions. Many related to project objectives, the role of the GSC and university researchers in the project, and money. The large volume of existing data relevant to this project was noted repeatedly, and initial efforts must focus on compilation of this data. It was agreed that the GSC could play a valuable role by simply finding out what individual researchers are studying and communicating this information to other interested parties.

As a result of the workshop, the GSC is forming two small working groups (lacustrine