QUATERNARY
PERSPECTIVES

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Editorial

Dear Readers,

The present issue of *Quaternary Perspectives* continues with contributions to the discussion on the status of the Quaternary as a stratigraphic unit. John Clague (INQUA President), Brad Pillians (President of the INQUA Commission on Stratigraphy and Geochronology), and Phil Gibbard (Chair of ICS Subcommission on Quaternary Stratigraphy) report about their experiences and discussions with ICS representatives at the 32nd International Geological Congress at Florence. One result of these consultations is the establishment of an official ICS/INQUA working group on the status of the Quaternary. A further note on the same topic is by Tim Naish, Alan Beu, and Brent Alloway who outline their "down under" perspective.

The viewpoint article is by James Shulmeister of Christchurch University who discusses the glaciations in New Zealand in the context of Quaternary climate change. Our series on national organisation continues with a special focus on the New World with reports from both South America and Canada. Finally, you will find a book review on the Marine Quaternary of Barbados and two conference announcements.

The homepage of *Quaternary Perspectives* in now updated and you will find there back issues for free download.

Frank Preusser and Christian Schlüchter
(University of Bern)

INQUA, IUGS, and the 32nd International Geological Congress

The Quaternary is by far the shortest of the geological periods, representing only the last 0.02% of known time. Yet it is arguably the most important period, receiving more attention from earth scientists than any other. In this context, Quaternary scientists, in general, and INQUA, in particular, played an important role at the 32nd International Geological Congress (IGC), which was held in Florence in August 2004. In this article, I briefly summarize INQUA's role at this important meeting; I focus on two issues that epitomize the uniqueness of the Quaternary Period and the sometimes uncomfortable relationship that its researchers have with other earth scientists. First, let me say a few words on INQUA's contribution to the 32nd IGC Congress. Its Commission on Terrestrial Deposits and Processes (TERPRO) and its Subcommission on Paleoseismicity and Neotectonics held business meetings during the congress. INQUA scientists organized and chaired several successful technical sessions (e.g. "Drylands in the Last Glacial Cycle", "Paleoseismology, seismic hazard and Quaternary geological evidence for earthquake deformation and faulting", "Marine Isotopic Stage 11—An equivalent to the Holocene?", and "Rapid and catastrophic geological changes and societal response"). Talks by Quaternary scientists at these and other sessions were among the best given at the meeting. Clearly, much of the positive energy in earth sciences today is coming from scientists working in the Quaternary Period.

The INQUA Executive also met with the Executive of the International Union of Geological Sciences (IUGS). Two important issues, both major irritants in relations between these two unions, were discussed: (1) INQUA's desire to become a Full Member of the International Council for Science (ICSU); (2) INQUA's opposition to proposed changes to the Geological Time Scale relating to the "Quaternary".

INQUA and ICSU

INQUA unsuccessfully applied for Full Membership in ICSU in 1998. At the XVI INQUA Congress in Reno, INQUA's International Council instructed the Executive Committee to consult with IUGS to determine the reason for the latter's opposition and to seek a solution that would allow INQUA to successfully reapply for full membership in ICSU. The International Council also instructed the Executive Committee to reapply for full membership in the current intercongress period.

INQUA and IUGS met informally to discuss this matter at the First International Conference on Geoparks in Beijing in June 2004. INQUA was represented by John Clague, and IUGS was represented by Ed de Mulder, Werner Janoschek, and Peter Bobrowsky. The discussion continued in Florence with members of the newly elected IUGS Executive Board; John Clague and Alan Chivas represented INQUA at this meeting. Clague and Chivas reaffirmed INQUA's desire to work with IUGS, but also stated that INQUA has concluded that the current situation, in which INQUA is an affiliate of IUGS rather than a full member of ICSU, is damaging the union. This current situation is inhibiting INQUA's ability to grow and to assume its rightful place in the family of scientific unions.

IUGS and INQUA decided that the informal discussions in Beijing and Florence would be elevated to a formal level. Clague will make a presentation on behalf of INQUA at the next IUGS Executive meeting, which probably will take place in Mendoza, Argentina, in January or February 2005. IUGS will then formally consider the INQUA-ICSU matter and decide on a course of action.

Quaternary and the Geological time scale

In the lead-up to Florence, ICS (International Commission on Stratigraphy, an IUGS body) proposed that the word "Quaternary" be removed as a formal chronostratigraphic unit from the Geological Time Scale. This

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proposal was immediately and vigorously opposed by INQUA Executive Committee, which polled the Quaternary community and found near-universal support for retaining "Quaternary" as a chronostratigraphic unit. Further, it found majority support for relocating the lower boundary of the Quaternary from 1.8 to 2.6 Ma.

Partly due to strong objections from INQUA, the matter was placed on the agenda of an ICS meeting in Florence. Many Quaternarists attended this meeting, including Clague, Brad Pillans (President of the INQUA Commission on Stratigraphy and Chronology), and Phil Gibbard (President of ICS's Subcommission on Quaternary Stratigraphy). Clague stated INQUA's position that "Quaternary" must be retained as a formal chronostratigraphic unit and that the base of the Quaternary should, if possible, be lowered to 2.6 Ma. He also voiced INQUA's unhappiness with the lack of consultation by ICS. Brad Pillans proposed that ICS and INQUA create a joint working group to decide the status of the Quaternary and report to ICS in time for its Second Workshop on the Future of Stratigraphy in September 2005 in Leuven, Belgium. The working group would include members of the INQUA Commission on Stratigraphy and Chronology and the ICS Subcommission on Quaternary Stratigraphy. Its recommendation would go through standard ICS consultation, voting, and ratification procedures and would also be considered at INQUA Cairns in 2007. INQUA and ICS are now working to formalize this working group.

John J. Clague (INQUA President)

Update on defining the Quaternary

Defining the Quaternary was one of the hot topics discussed at the 32nd International Geological Congress held in Florence, with the main forum being the open general meeting of the International Commission on Stratigraphy (ICS) held on the 26th of August. With the new ICS Geological Time Scale (GTS) wall chart on sale at the congress, minus the Quaternary as a formal chronostratigraphic unit, the stage was set for INQUA to lobby for reinstatement of the "lost" Quaternary.

The Quaternary agenda item at the ICS open meeting was begun with a joint presentation by Jim Ogg (Secretary General of ICS), and myself as President of the INQUA Commission on Stratigraphy and Chronology. Jim noted that the Quaternary had never formally been defined as a chronostratigraphic unit, and then summarised some of the options for how it might now be defined (see Fig. 1), including both formal and informal definitions. I followed by saying that while my personal preference (as outlined in the previous issue of *Quaternary Perspectives*) was for formal definition as a Subsystem of the Neogene, the decision should be made by a joint INQUA-ICS working group. John Clague (INQUA President) and several INQUA members also presented their views in support of the Quaternary as a formal chronostratigraphic unit.

Having previously discussed the matter with John Clague and Phil Gibbard (chair of the ICS Subcommission on Quaternary Stratigraphy—SQS), I made the following recommendations to the ICS meeting:

1. That the Quaternary be defined as a chronostratigraphic unit in the GTS.
2. That the base of the Quaternary be defined at 2.6 Ma, i.e. at the Gelasian GSSP, encompassing the time of bipolar glaciation and humans as tool-makers.
3. That a joint INQUA-ICS Working Group be established to include the chair (Gibbard) and three other members of the SQS, the chair (Pillans) and 3 other members of the INQUA Stratigraphy and Chronology Commission, the chair of the Neogene Subcommission and the chair of one other ICS subcommission.

Note that recommendation 2 makes no mention of the rank of the Quaternary in the GTS—that decision will be made by the working group.

I am pleased to report that Recommendation 3, above, has been acted upon by ICS, and that a joint agreement was recently announced by Felix Gradstein (ICS President) and John Clague (INQUA President)—see below. This should allow the Quaternary to be reinstated to the GTS before 2008, which is the ICS deadline for defining GSSP's for all Phanerozoic chronostratigraphic units of stage rank or above.

The crux of the Quaternary definition debate comes back to the 1985 paper that formalised the Vrica stratotype for the Plio/Pleistocene boundary, in which Aguirre and Pasini stated (1985, p. 116) that "The subject of defining the boundary between the Pliocene and Pleistocene was isolated from… the status of the Quaternary within the chronostratigraphic scale". Nowhere in their paper, nor indeed anywhere else (that I know of), is the base of the Quaternary formally defined as corresponding to the Plio/Pleistocene boundary. The Quaternary was subsequently shown as a System/Period above the Neogene on various GTS wall charts (e.g. Harland et al., 1990), but apparently never formally ratified as such. Thus by common usage, the base of the Quaternary System has continued (informally) to be equated with the Plio/Pleistocene boundary. Similarly, in their paper on formally defining the GSSP for the base of the Neogene Period/System, Steininger et al. (1997) make no mention of defining its upper boundary. Thus, Quaternarists might equally argue that the Neogene remains formally "undefined".

In discussions that I had with various ICS members during the Florence meeting, there was general support for defining the Quaternary as a Subsystem of the Neogene. Such a definition was seen as a good compromise between the various factions. However, as Phil Gibbard has pointed out, if the Quaternary Subsystem is defined to include the Gelasian Stage, with base at 2.6 Ma, and the

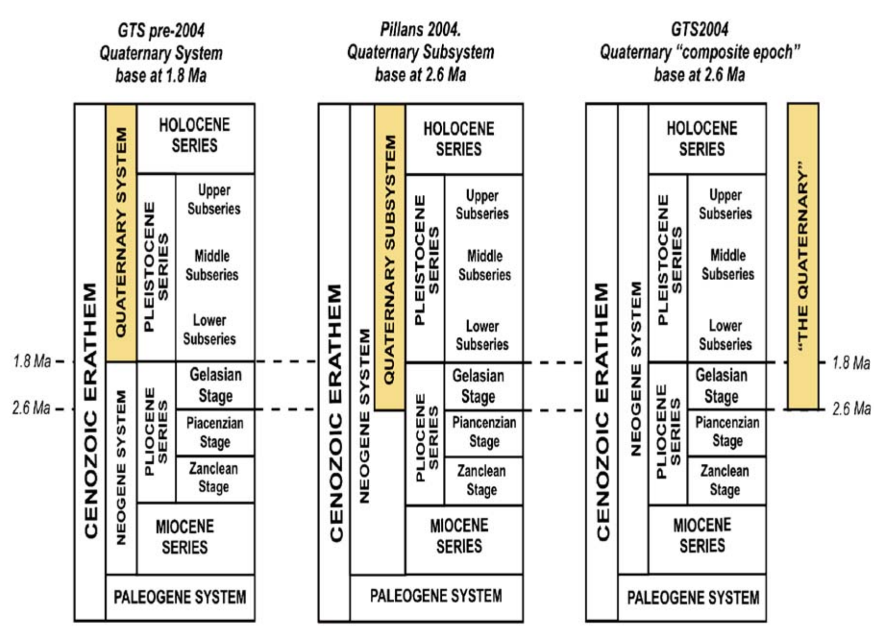

Fig. 1. Some options for defining the Quaternary.

Plio–Pleistocene boundary remains at 1.8 Ma (decoupled from the base of the Quaternary), this leads to a non-hierarchical point on the GTS, i.e. the boundary of higher rank (Subsystem) does not correspond with a boundary of next lowest rank (Series). However, as Harland et al. (1982, p. 7) stated

"*A hierarchy is not essential, and if one is used it matters little whether the distinct ranks in the hierarchy are strictly maintained. Provided each span is properly defined, then usage will consolidate a suitable number of names*".

I interpret this statement to mean that while a hierarchical scheme is a theoretical nicety, the overriding principle ought to be one of practicality. Whether that will be the resolution of the task force remains to be seen. In the meantime, I have taken the opportunity to discuss the various options in Quaternary Science Reviews (Pillans and Naish, 2004).

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Brad Pillans

(President INQUA Stratigraphy and Chronology Commission)

Quaternary...now you see it, now you don't!

Perhaps you were wondering whether there had been any developments in the discussions on the state of the term Quaternary that we reported in these pages last issue (Clague et al., 2004; Gibbard, 2004; Pillans, 2004), following the International Geological Congress (IGC) in Florence? Well, there is good news and there is bad news.

First the good news. Two meetings were held at the Congress. The first was a meeting of the International Commission on Stratigraphy's Subcommission on Quaternary Stratigraphy (SQS) to present progress on the division of Quaternary time. Although it was held on the first afternoon, at the same time as the prestigious opening ceremony, the meeting was well attended. The question of the definition of the Quaternary was not the main topic on the agenda but was inevitably brought up and initiated a lively discussion. Following a suggestion by Professor Cita, the participants voted on two proposals:

1. Should the Quaternary be maintained as a formal chronostratigraphic unit?
2. Should the Quaternary be kept at system rank or subsystem rank?

The first question was carried by 28 in favour and 1 against, and to the second 25 were in favour of retaining a system rank, 1 in favour of subsystem rank and there were 3 abstentions. These results confirm the INQUA position laid out in the previous *Quaternary Perspectives* (Clague et al., 2004). The results of these discussions were communicated to the ICS by the SQS board.

And the bad news? Throughout the meeting members of the Quaternary community were agitating for a solution to the attempted suppression of the term. This sense of unease was not helped by the fact that the ICS were selling their new time scale chart (produced to accompany the new, extensively revised edition of the *Geologic Time Scale* that will be published shortly—Gradstein et al., 2004, Fig. 1C). In contrast to previous versions (Fig. 1A and B), the word Quaternary is omitted from this table; Pleistocene and Holocene being shown within the Neogene Period, which therefore extends to the present. Since nothing has been agreed, or even discussed, except between the ICS' executive officers, this decision to produce a chart that will go around the world showing the unofficial situation is somewhat premature. It is, however, important to realise that neither the chart nor the volume it accompanies are technically official publications of the ICS, approved by the IUGS, but independent documents.

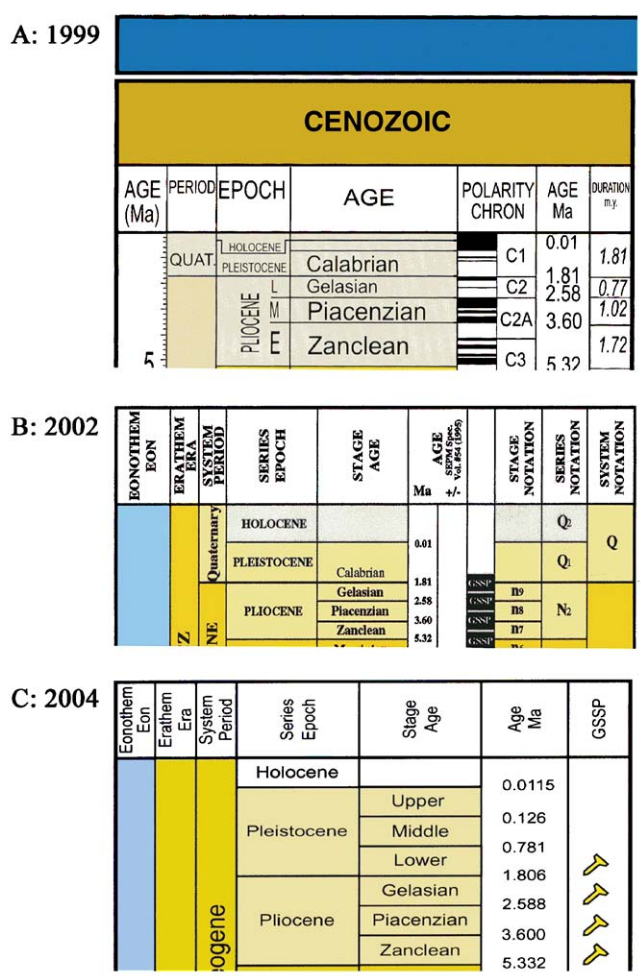

Fig. 1. Examples of the division of the late Cenozoic Era in geological time tables produced for the International Commission on Stratigraphy (ICS). (A) Gradstein and Ogg (1999), (B) Remané et al. (2002), (C) Gradstein et al. (2004). The blue box indicates the Phanerozoic Eon.

Global Boundary Stratotype Sections and Points (GSSPs)

Status in March 2004; see ICS website (www.stratigraphy.org) for updates.

EON, Era, System, Series, Stage	Age (Ma) GTS2004	Est. ± myr	Derivation of Age	Principal correlative events	GSSP and location
PHANEROZOIC					
Cenozoic Era					
Quaternary System					
Holocene Series					
base Holocene Series	11.5 ka	0.00	Carbon-14 dating calibration and laminae counts of varved sediments and ice	Exactly 10,000 Carbon-14 years (= 11.5 ka calendar years BP) following the Younger Dryas Chronozone and the end of Greenland Stadial 1	
Pleistocene Series					
base Late Pleistocene Subseries	0.126	0.00	Initially dated using astronomical cyles. Now dated using U/Th and OSL.	Base of the Eemian interglacial Stage (~base of Marine Isotope Substage 5e) before final glacial period of the Pleistocene	Potentially, in the Amsterdam Terminal borehole, the Netherlands
base Middle Pleistocene Subseries	0.781	0.00	Dating of volcanic rocks (K/Ar and Ar/Ar)	Brunhes-Matuyama magnetic reversal	
base Pleistocene Series	1.806	0.00	Astronomical cycles in sediments and dating of volcanic rocks (K/Ar and Ar/Ar)	Just above top of magnetic polarity chronozone C2n (Olduvai). Above are lowest occurrence of calcareous nannofossil medium Gephyrocapsa spp. and extinction level of planktonic foraminifer Globigerinoides extremus.	Top of sapropel layer 'e', Vrica section, Calabria, Italy
Neogene System					
Pliocene Series					
base Gelasian Stage	2.588	0.00	Astronomical cycles in sediments and magnetic polarity	Marine Isotope Stage 103, base of magnetic polarity chronozone C2r (Matuyama). Above are extinction levels of calcareous nannofossil Discoaster pentaradiatus and D. surculus (base Zone CN12c).	Midpoint of sapropelic Nicola Bed ("A5"), Monte San Nicola, Gela, Sicily, Italy

Fig. 2. Current recommendations of the ICS' Subcommission on Quaternary Stratigraphy (2003).

The reason that we later discovered from Jim Ogg, the ICS' Secretary, was that the term Quaternary has apparently never been formally defined and therefore cannot be included in the chart (for his opinion, see Ogg, 2004). Although this point is debatable, it is important to understand that the current ICS management only accept terms that have been "defined-formally"; effectively "if it isn't defined, it doesn't exist". Leaving aside the fact that the term has been in continuous use for 200 years, the unilateral decision to drop it from the geological timetable chart reflects the opinion policy that chronostratigraphical terms must be defined to meet the ICS' criteria. In reality this shows that both (1) the ICS procedure of voting/ratificationing etc., and (2) individual policy decisions by the ICS secretariat, can produce results that run counter to mainstream opinion and usage, sometimes dramatically so (e.g. Tertiary). It is unclear whether all the major system names etc. have been subjected to this test. What this means for Quaternary is that it is up to us all to save it, if we want it to continue to have a formal stratigraphical meaning, especially at system level, a process for which we have strong support across the board (e.g. Gibbard et al., 2005).

At the general public meeting of the ICS, a week later, it became clear that longevity of usage is not an argument that cuts any ice with the ICS executive. Here it seems that ICS policy diverges markedly from biological nomenclature where conservation of long-established names is accepted as a criterion for their continued use. Discussion of the status of the Quaternary was carefully managed at this meeting. Here Jim Ogg presented his view that the term, unlike the Pleistocene and Holocene, lacked formal definition (Ogg, 2004), and Brad Pillans followed with his proposal to regrade the term to a subperiod (subsystem), previously presented in these pages (Pillans, 2004). Dissent and discussion was restricted, although John Clague (INQUA President), Charles Turner and others made a series of impassioned appeals to the ICS to consult the user community and accept the real situation. The session was halted by lunch and afterwards nothing more was discussed. Personal appeals by Brad Pillans and myself to Felix Gradstein (ICS President) at the end of the meeting revealed that he had decided to accept our joint suggestion, to establish a group to discuss the status and definition of the term. We proposed to convene a committee comprising four members of the ICS' SQS, four from the INQUA SACCOM, and two others, one from ICS' Neogene Subcommission and a neutral chairman (the chair of another system subcommission).

That is where we are today, awaiting the establishment of this committee, with neither closure nor substantial advance on the pre-Florence situation. In the meantime the status of the term Quaternary hangs in a void, at least as far as the ICS is concerned. So what is one to do about using the term in the interim? Jim Ogg recommends that it should not be used! Clearly this is not an option for Quaternary workers. The SQS, like the INQUA Executive (Clague et al., 2004), take the opposite view (Fig. 2). Since these discussions could last many years, no one should stop using Quaternary; the term that has served us so well for so long. Even if the ICS choose to believe that it's status is uncertain, the vast majority of the user community do not share this opinion. It is a pity that the ICS management could not accept a small loss of face by backing-down from this unfortunate and ill-advised *contre-temps*…

If there is a lesson to be learnt from this, it is that we in the Quaternary have not been doing our job properly in the past. We have allowed terminology to become established without taking care to ensure that it is properly defined, a process that is still happening. Although it is understandable how these things can arise, as our subject advances at lightning speed, we have ourselves to blame partially for the current problems. Several examples of stratigraphical or quasi-stratigraphical terms that we use daily might be consider by others to be un-, or at best, ill-defined, e.g. the Last Glacial

Maximum, Heinrich event, etc. It is time to "get our house in order" so that these terminological tangles can be avoided in the future.

The message seems to be that if we want to retain the Quaternary as a formal term and an indispensable concept, then we will have to keep using it, and to organise to ensure that it is returned to the global geological column.

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I thank Jan Zalasiewicz for commenting on an earlier version of the text.

Phil Gibbard (Chair, Subcommission on Quaternary Stratigraphy)

Announcement of the ICS-INQUA joint task force on the Quaternary

Rationale

For over a century, the status and stratigraphic position of the Quaternary have been debated. Authoritative papers on the history of Quaternary, and its recommended stratigraphic definition and status include Berggren (1989), Lourens et al. (2004), Ogg (2004), and Pillans (2004). The INQUA Executive, through consultation with the Quaternary community in 2004, has found widespread support for defining the Quaternary as a chronostratigraphic unit with a base at 2.6 Ma. As a consequence, ICS and INQUA consider it timely to decide on the stratigraphic meaning of the Quaternary, so that it can be unequivocally placed in the standard global time scale. John Clague, President of INQUA, Felix Gradstein, Chair of ICS, assisted by outgoing IUGS President Ed de Mulder, have agreed that a task force be struck that will make a recommendation to ICS on the definition of the Quaternary in 2005.

Task force

The task force on the Quaternary will comprise members of INQUA and ICS, and will be charged with the single task of defining the Quaternary in a stratigraphic sense. It will formulate a single proposal that will be discussed at the Second ICS Workshop on the Future of Stratigraphy in September 2005 in Leuven, Belgium. This workshop will be attended by the chairs of all Subcommissions of ICS, and the President of the INQUA Commission on Stratigraphy and Geochronology. If the task force recommends definition in a formal chronostratigraphic sense, its proposal will go through the standard ICS consultation, voting, and ratification procedures.

The task force will consist of eight members and will receive advice and input from its wider constituency. The members of the task force are

Chair: *James Gehling, Australia*
Vice-Chair: *Brad Pillans, Australia*
Secretary: *James Ogg, USA*
Two members of INQUA Commission on Stratigraphy and Geochronology, appointed by the executive of INQUA
Three members of ICS Subcommission on Quaternary Stratigraphy, appointed by the executive of ICS.

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Felix Gradstein and John Clague

What does the term "Quaternary" mean in New Zealand?: Historical usage and a way forward

Historical use of the Quaternary

The Pliocene–Pleistocene boundary in New Zealand has historically been placed at the earliest faunal evidence of climatic cooling in southern North Island sedimentary basins, as shown by the first occurrence of the subantarctic scallop *Zygochlamys delicatula* commonly in association with the cool-water crab *Jacquinotia edwardsii* (Fleming, 1953; Beu et al., 1987). In Wanganui Basin this occurs at the base of the Hautawa Shellbed, which defines the base of the New Zealand Nukumaruan Stage SSP. When Fleming (1944) first drew attention to the paleoclimatic significance of *Z. delicatula*, several hundred kilometres north of its modern range, the Nukumaruan Stage was considered to be Pliocene in age. Subsequently, with the proposal of an international Pliocene–Pleistocene boundary at the horizon of first cooling in the Italian Neogene succession at the base of the Calabrian Stage in 1948, the way seemed clear to correlate the boundary to the base of the New Zealand Nukumaruan. Although such a correlation is widely attributed to Fleming (1953), he qualified the correlation by admitting that "more evidence is desirable before such a step be taken" (p. 127). His qualification was apparently ignored, and after an internal review in 1956 the director of the New Zealand Geological Survey recommended that the Pliocene–Pleistocene boundary (Ongley, internal memo) be correlated with the base of the Nukumaruan Stage, with the result that much of what had been considered Pliocene was now placed in the Pleistocene. Given the long historical association of the base of "Quaternary" with the base of the European Calabrian Stage (Deperet, 1918), and its terrestrial correlative the Villafranchian Stage, the base of Quaternary in New Zealand was also tied to the base of the Nukumaruan at this time. Early palynological investigations in New Zealand (e.g. Couper and McQueen, 1954) showed evidence of significant cooling in rocks of

Lower Nukumaruan age, including glacial deposits at Ross on the west coast of the South Island. Thus the Lower Nukumaruan became firmly established within both marine and terrestrial sequences as representing the time of earliest Pleistocene cold (see also Gage and Suggate, 1958; Gage, 1961).

Biostratigraphic subdivision of the Quaternary in New Zealand (Fig. 1), largely based on endemic molluscan fauna, was recognised by Fleming as problematic, as many taxa, such as *Z. delicatula*, have interrupted ranges owing to fluctuating climatic conditions. These difficulties led to a range of non-paleontological criteria (evidence of glaciation, chronology based on eustacy) being employed to subdivide the Quaternary into a system of local stages (Fig. 1). Historically, New Zealand Quaternary deposits were classified into two series equivalent to the Upper and Lower Quaternary. Sediments of the Upper Quaternary included the deposits of four major glacial advances on the South Island and intervening warm periods (Suggate, 1965). Those of the Lower Quaternary where thought to be closer in nature to preceding Pliocene sediments but contained paleontological and glacio-eustatic evidence for two broad cold and warm periods, with glacial deposits of one cold period being known in South Island (Ross Glacial). The biostratigraphic subdivisions of the Lower Quaternary were first proposed as substages of the Nukumaruan and Castlecliffian Stages (Fleming, 1953), but were later given stage status as the sequence Hautawan (cold), Nukumaruan (warm), Okehuan (cold) and Castlecliffian (warm). Upper Quaternary glacial sediments in the South Island were correlated with four glacial stages and four intervening interglacial stages (Fig. 1). Difficulties with their recognition outside of type localities meant that the substages were not widely utilised. Moreover, publication of the first oceanic oxygen isotope records (e.g. Shackleton and Opdyke, 1973) heralding the orbital theory of the ice ages (Hays et al., 1976) led to the recognition of a higher frequency glacio-eustatic cylostratigraphy in the New Zealand Quaternary (e.g. Beu and Edwards, 1984), resulting in the eventual abandonment of climatically influenced substages (following the suggestion of Beu, 1969).

It is clear that the definition of Quaternary in New Zealand has its historical basis firmly entrenched in the paleontological, geomorphological and sedimentological recognition of the onset of major cooling and climatic fluctuations. However, age estimates for base of the Nukumaruan Stage based on early radiometric and fission track dates ranged from 2.2 to 2.6 Ma (Matthews and Curtis, 1966; Stipp et al., 1967). Kennett et al. (1971) also presented isotopic and faunal evidence of climate cooling in Wairarapa close to the Gauss–Matuyama (G/M) polarity transition (then dated at 2.43 Ma), but noted that the internationally accepted Pliocene–Pleistocene boundary at the base of the Calabrian Stage in Italy probably lay close to the base of the Olduvai (Gilsa) event at about 1.79 Ma. Thus, by the early 1970s, there was already considerable uncertainty about the age and position of the base of the Quaternary in New Zealand. This was partly because the internationally proposed Pliocene–Pleistocene boundary had yet to be rigorously defined and dated. With formal designation and characterisation of the GSSP in the Vrica section in southern Italy (Backman et al., 1983; Tauxe et al., 1983; Aguirre and Pasini, 1985), the way was open to establish the precise position of the boundary in New Zealand using all available techniques, but particularly biostratigraphy, tephrochronology and magnetostratigraphy of the marine sediments in shallow marine North Island sedimentary basins. The magnetostratigraphy of the Pliocene–Pleistocene boundary stratotype at Vrica indicated a stratigraphic location for the boundary immediately above the top of the Olduvai Subchron. Early magnetostratigraphic and tephrostratigraphic studies in Wanganui Basin (Seward et al., 1986) demonstrated that the base of the Nukumaruan Stage was closer to the G/M (2.43 Ma) polarity transition than it was to the top of the Olduvia Subchron (1.79 Ma). Subsequently, Beu and Edwards (1984) showed that the boundary, as defined at Vrica, lay within the middle of the Nukumaruan Stage, well above the Hautawa Shellbed. While never formally defined, the base of the Quaternary has continued to be linked to the Pliocene–Pleistocene GSSP. Thus since the late 1980s the Quaternary Period in New Zealand has essentially been decoupled from the onset of major northern hemisphere glaciation and associated global climate fluctuations.

The current use of Quaternary

In remarkable anticipation of the first high-resolution isotope records linking global ice volume and sea-level to Earth's orbital variations, Fleming (1953, Fig. 62) recognised as many as 35 "fluctuations in Pleistocene sea-level" in Wanganui Basin. Unable to explain the origin of these water depth changes within the "four glacial" European paradigm of the time he turned to local crustal "yo-yoing". Armed with oxygen isotope records and

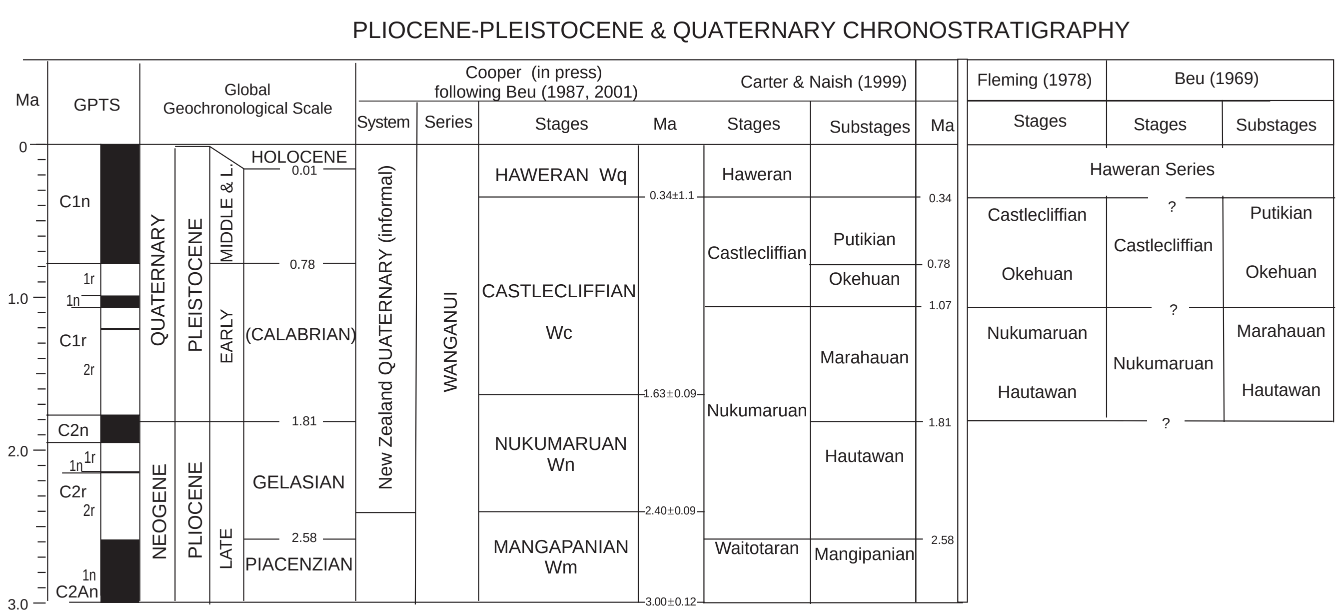

Fig. 1. History of the chronostratigraphic subdivision of Plio–Pleistocene and Quaternary sedimentary deposits in New Zealand.

sequence stratigraphy we now recognise Fleming's "base level" changes in Wanganui Basin as the product of 41 and 100 ka-duration global glacio-eustatic sea-level cycles spanning oxygen isotope stages 100 (2.46 Ma) to 5 (0.125 Ma) (Naish et al., 1998)—a remarkably complete record of shallow-marine sedimentary cyclicity since the onset of major northern hemisphere glaciations (Fig. 2). The development of an astronomically tuned cyclostratigraphy for the 3 km thick shallow-marine late Pliocene–Pleistocene marine succession in Wanganui Basin, supported by glass-FT dates of tephra interbeds (i.e. Alloway et al., 1993; Pillans et al., 1994) allowed precise location of the base of the Quaternary in New Zealand as defined at the Vrica stratotype (Naish et al., 1996). This lies 60 m stratigraphically below the Vinegar Hill tephra (1.75 ± 0.13 Ma) in the upper part of the Olduvai Subchron, at the base of the shelf siltstone of the highstand systems tract of Wanganui Basin Sequence 17, corresponding to the top of interglacial Oxygen Isotope Stage 65 (Fig. 2). As currently defined the Quaternary encompasses the upper part of the Nukumaruan (2.40–1.63 Ma), Castlecliffian (1.63–0.34 Ma) and Haweran (0.34 Ma to present) stages (Beu, 2001). However, because of the historical association of the Quaternary in New Zealand with the onset of climatic deterioration at around 2.5 Ma., many Kiwi "Quaternarists" have continued to extend their use of Quaternary to the base of the Nukumaruan Stage (Hautawa Shellbed = MIS Stage 98-97). There is no faunal or sedimentological expression of major climate change at the Pliocene–Pleistocene boundary in the New Zealand region. This led Naish et al. (1997) to support renewed discussions within the INQUA Commission of Stratigraphy to lower the Pliocene–Pleistocene boundary to a level near the G/M polarity transition, and to propose the Rangitikei valley section in Wanganui Basin as a southern hemisphere reference (published in the special issue of *Quaternary International* on the Pliocene–Pleistocene boundary). Recent ratification of the Vrica GSSP by the International Commission on Stratigraphy (ICS) has fixed the Pliocene–Pleistocene Boundary is at 1.81 Ma, for the next 10 years at least.

On the future use and definition of Quaternary

The definition of "Quaternary" remains a grey area. While there is strong historical precedence for its usage extending back to the early 18th century (e.g. Desnoyers, 1829; Gignoux, 1910, 1913), the term has never been formally defined as a chronostratigraphic unit. A number of classification schemes have seen the Quaternary used as a system or period above the Neogene. However, many consider that the Quaternary is not a satisfactory term as the original hierarchy of Primary and Secondary have been replaced by Paleozoic and Mesozoic respectively, and Tertiary has been replaced by Paleogene and Neogene. The ICS currently considers the "Quaternary" informally as an interval of oscillating climatic extremes (glacial–interglacial episodes) that was initiated at about 2.5 Ma, therefore encompassing the Holocene, Pleistocene and uppermost Pliocene. This fits well with the current usage of many New Zealand Quaternary stratigraphers. In the revised geological timescale (GTS2004) Gradstein et al. (2004) propose to extend the Neogene System (Period) up to the present thereby making the Quaternary System redundant. By way of a compromise Brad Pillans has proposed to redefine the Quaternary as a Subsystem (Subperiod) of the newly defined Neogene and that its base be defined as the base of the Pliocene Gelasian Stage at 2.6 Ma (GSSP ratified—Rio et al., 1994). Pillans argues that redefinition of the Neogene System provides an opportunity to formally define the Quaternary for the first time in a way that is consistent with its historical and popular usage. His proposal is certainly consistent with the philosophy and practise followed by the vast majority of New Zealand Quaternary stratigraphers for more than half a century and recognises the paleoclimatic significance of the time interval. It has the added benefit that it may put an end to the sterile and now rather futile debate over the Pliocene–Pleistocene boundary once and for all!

So finally, we ask the question, "what is in a name?". Will the formal definition of Quaternary advance our science or improve the communication of our science? Will we remain "Friends of the Pleistocene?" Does the inclusion of the Quaternary as a chronostratigraphic unit provide a more useful means of subdivision and correlation of young geologic strata than the currently defined International Series and Stages? Or are endeavours to "save the Quaternary" really rooted in more emotive issues such as the need to define a handle for a group of multidisciplinary researchers focused on the last 2.5 Ma of Earth's history, and in doing so, provide a sense of belonging and identity? Quaternary still means many different things to many people, and it is unlikely that everyone will be pleased with a definition linking it to the base of the Gelasian Stage. If one wanted to play devil's advocate one could say that we already have a perfectly useful GSSP at the base of the Gelasian tied to the G/M polarity transition and oxygen isotope stage 104 which marks the onset of major "Quaternary" climate fluctuations. The counter to that is that perhaps we need a higher order of unit that spans the late Neogene "glacial world". These are important questions that will be discussed by ICS, the INQUA Commission on Stratigraphy and its members as they consider the Pillans proposal. Though these might be tough questions to answer, we in New Zealand like the term Quaternary. We have used it for many years, it is like an old friend to us and we know what we mean when we use it. After all, do not we have an impressive range of Quaternary sediments in New Zealand…and are they not world class?! Without wanting to appear flippant, we support the endeavour of Brad Pillans to formalise the term. It should improve communication amongst Quaternarists, and at the very least it will allow us to keep on crowing about our world class "Quaternary" stratigraphy!

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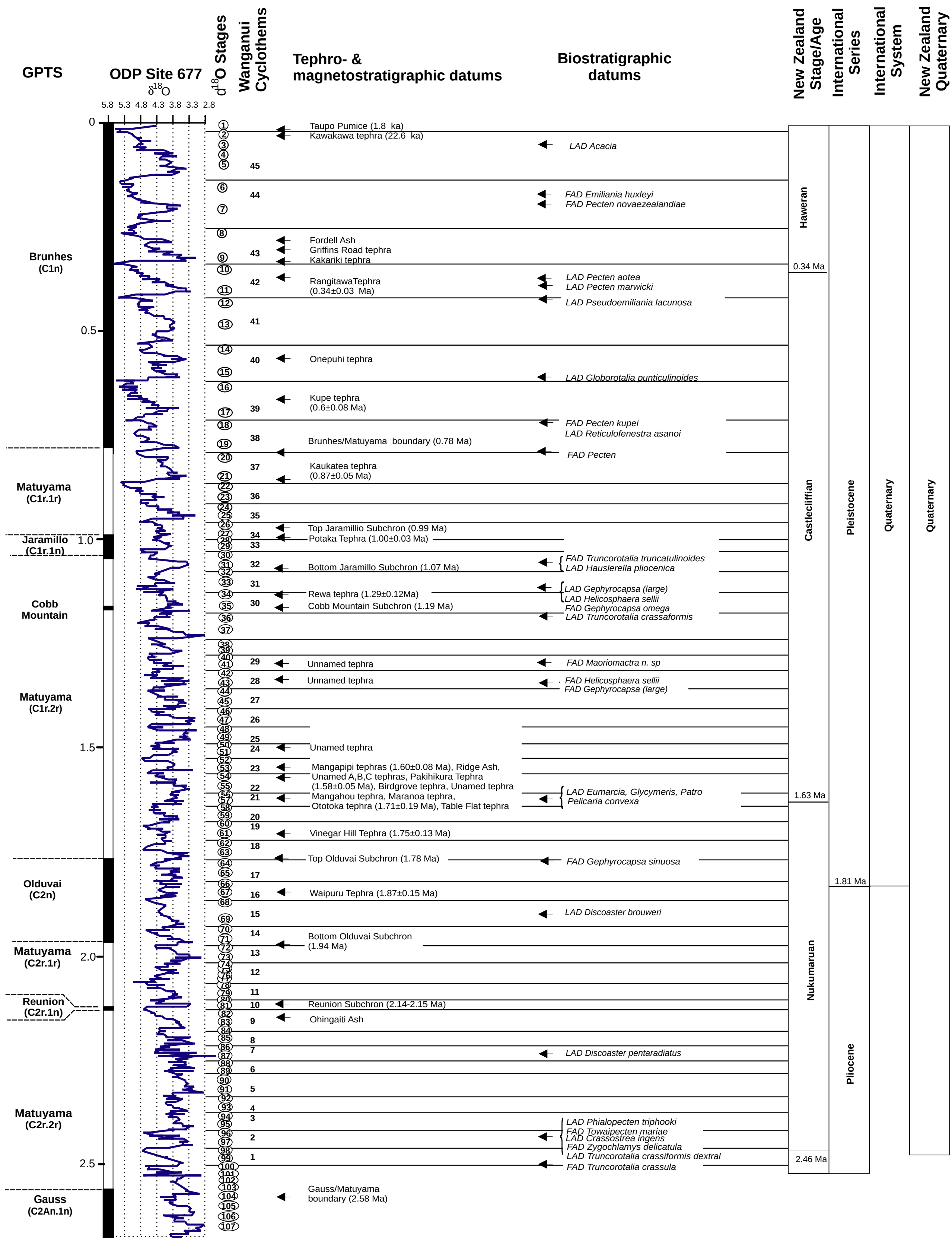

Fig. 2. Integrated chronostratigraphy for "Quaternary" shallow-marine sediments, Wanganui Basin.

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Late Quaternary glaciations in New Zealand. Is the answer blowing in the wind?

Introduction

New Zealand is frequently cited as a key distal location to examine global transmission of climatological or oceanographic signals from the Northern Hemisphere (usually the North Atlantic) (e.g. Broecker, 1997). A particular focus has gone on the last deglaciation in New Zealand, starting with straightforward attempts to directly track North Atlantic climate events such as the Younger Dryas to New Zealand (e.g. Burrows, 1979; Mercer, 1988; Denton and Hendy, 1994). More recently, focus has shifted to discerning timing differences between a Northern Hemisphere/Southern Hemisphere see-saw mechanism (e.g. Turney et al., 2003) against direct atmospheric transmission of a Northern Hemisphere climate signal (e.g. Ivy-Ochs et al., 1999) and to understanding local responses to the global signals (e.g. Singer et al., 1998). In terms of climate events, Southern Ocean/Antarctic events such as the Antarctic Cold Reversal are gaining currency (e.g. Pepper et al., 2004), as evidence of at least some climatic shifts asynchronous with the Northern Hemisphere, has emerged.

Exciting though the deglaciation history is, the focus on the deglaciation has tended to obscure our lack of understanding of the basic patterns of glaciation in New Zealand. In this perspective piece, I will examine the last glacial maximum (LGM) in New Zealand, highlight deficiencies in our knowledge, the progress that has been made in recent years and indicate both where I think the answers lie and some of the problems that need to be addressed.

The LGM Paradox in New Zealand: Sea Surface Temperatures (SST) and terrestrial vegetation

On the eastern side of New Zealand, the east–west aligned Chatham's Rise (41°S: see Fig. 1) forms a major barrier to water masses. It currently separates sub-tropical water to the North from sub-Antarctic water to the South. At LGM times this barrier was topographically enhanced by sea-level fall and more thermally pronounced, as polar water replaced sub-Antarctic water south of the Rise. SSTs south of the Chatham Rise were c. 8 °C cooler (Barrows et al., 2000) at the LGM while lesser but still substantial cooling (4–6 °C) occurred North of the rise. The SSTs from the eastern side are uncontroversial but play little role in determining the nature of the LGM climate in New Zealand as they are downwind of the weather direction.

In contrast, the movements of marine fronts in the Tasman Sea are poorly described but are critical to understanding the vegetation pattern. The network of stations in the eastern Tasman Sea off New Zealand is relatively poor, but foraminfera derived temperature reconstructions suggest 3–5 °C of cooling at the LGM on the Challenger Plateau, at the latitudes of the north of South

Island and the North Island (Barrows et al., 2000).

This 3–5 °C of cooling cannot explain the LGM pattern of vegetation onshore in New Zealand. Both the SSTs and Equilibrium Line Altitude depression of snowline estimates (e.g. Porter, 1975) would be consistent with the widespread survival of forests at lower elevations across New Zealand, including the far south of South Island. In fact early workers such as Willet (1951) and Wardle (1963) explicitly proposed forest survival across much of lowland New Zealand, not occupied by ice. Vegetation reconstructions, based largely on pollen studies (see summary in McGlone et al., 1993), however, demonstrate that, at the LGM, continuous forest was limited to North of the 38°S latitude in the far North Island, with occasional forest patches further south and virtually no trees in the east and south of the South Island. The pollen studies are numerous, though spatial coverage in the east and south of South Island is patchy, but there are no reasons to believe that they are inaccurate.

Reconciliation of the records has proved problematic. Data from the TASQUA cruise is expected to be published soon, but it is unlikely that the problem of the terrestrial vegetation, marine record conciliation is actually due to the incorrect specification of SSTs and the SST pattern is likely to be refined rather than over-turned.

The issue appears to relate to the climatic meaning of treeless landscapes. McGlone et al. (1993) argued that extreme weather, notably cold air outburst, and droughty conditions in Eastern New Zealand could create conditions on land that were more severe than the simple temperature depression suggested. I concur with McGlone that these factors will come into play but I believe that landscape disruption, especially on the rapidly aggrading braid plains of glacially fed rivers, is also very important and could exclude forest from lowland areas, especially in the east and south of the South Island that were still climatically suitable for trees. Increased colluvial activity in hilly areas would also diminish forest cover. Quantitative reconstructions of terrestrial paleoclimates are needed to resolve the temperature issue.

A long monotonous LGM?

Many New Zealand records suggest a prolonged and monotonic glacial maximum in New Zealand. In fact, many sites imply a bimodal climate with interglacial deposits strongly contrasted with glacial age sediments and little gradation within glacial periods (e.g. Shulmeister et al., 2001). Indeed, such was the apparent uniformity of OIS 2 in New Zealand, that Pillans et al. (1993) used the widespread Kawakawa tephra (c. 26,000 calendar years ago) as a marker for the onset of the LGM. This became widely accepted even though it placed New Zealand out of synchrony by c. 4–5000 years with the global onset of the LGM because it appeared to reflect a genuine early onset of LGM conditions in New Zealand (e.g. Hellstrom et al., 1998). In the last few years, however, detail has started to appear within the LGM and the monotony and duration of the New Zealand LGM chron are now open to re-examination.

The glacial evidence has always suggested a complex LGM. In eastern South Island valley systems, the LGM advances are attributed to moraine complexes that typically display several distinct terminal positions. For example, in the Rakaia Valley in Canterbury (Figs. 2 and 3), the LGM moraine sequence is defined as the Bayfields sequence which comprises two distinct moraines in the main valley and three in the tributary Lyndon Stream valley (Soons, 1963; Soons and Burrows, 1978). Lack of a proper chronological framework, however, has made it virtually impossible to infer patterns of glaciation at the LGM. The Bayfields moraines in the Lyndon Stream are the only dated LGM advances on the eastern side of the divide. The ages are not on the moraines themselves and correlation back to the main Rakaia Valley is not simple. Even if the chronologies are correct, it is uncertain how much climate change can be read into terminus fluctuations of a few hundred metres. This again relates back to the poor chronology, as the fluctuation might represent either a small-scale local shift or major retreat and re-advance.

Only on the West Coast of the South Island has a radiocarbon chronology extended to the LGM in sites actually dating glacial advances. Here the Kumara 2-2 advance (Suggate, 1990) is securely dated to the LGM. A significant issue on the West Coast has been the apparent failures of many dating techniques to provide robust results. This appears to stem from some genuine difficulties in applying the techniques in this hyper-humid environment (e.g. Almond et al., 2001; Berger et al., 2001 for luminescence dating) but there is strong suspicion that some valid radiocarbon ages may have been rejected simply because they were inconsistent with the model of glaciation. This is particularly a problem in pre-LGM sites but is also an issue in some younger cases.

New dating techniques, and the more rigorous application of existing techniques is beginning to turn these problems around. For example, Hormes et al. (2003) undertook an intensive examination of an LGM site in the Grey Valley in North Westland. This study involved 55 radiocarbon and 8 luminescence age determinations from silt inter-beds between two glacial outwash gravels attributed to separate OIS 2 advances. The silt interbeds formed over a period of no less than about 600 years between about 22,300 and 22,900 years ago. The biotic remains in the silt beds are not particularly climate diagnostic, as they overwhelmingly represent swamp taxa, but they do support a non-glacial interval and not

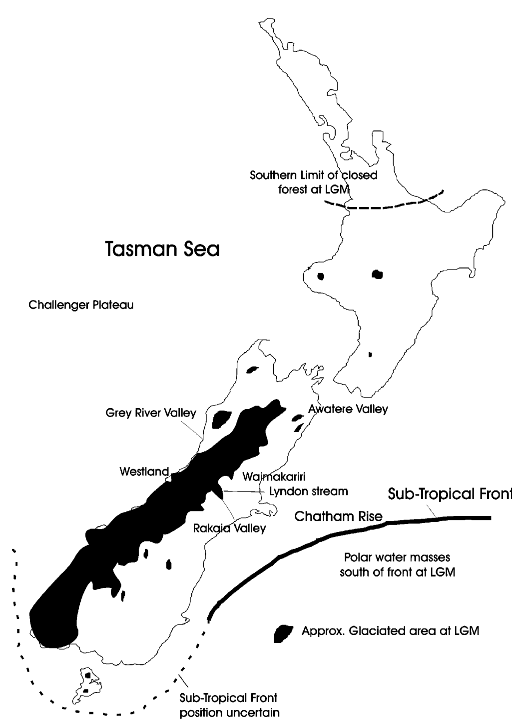

Fig. 1. Location map showing all the sites listed in the text.

Fig. 2. The Bayfield moraine on the South side of the Rakaia Valley is typical of the LGM moraines in this part of New Zealand. It is volumetrically very small rising only c. 5 m above the gravel aggradation surface and is very narrow. It is also undated at this location as are most 'LGM' moraines in New Zealand.

Fig. 3. Spectacular flights of terraces are visible at Rakaia Gorge. The highest terrace surface visible is the Tui Creek surface (undated but inferred to be oxygen isotope stage 4) and the lower terraces are associated with LGM and late glacial readvances and Holocene incision. Note the scale of the glacial outwash fans in contrast to the terminal moraine in Fig. 7.

simply a short-lived flow diversion. Several groups are now working on developing glacial chronologies based on luminescence and cosmogenic dating and rapid progress in this area can be expected.

Pollen studies will remain the primary basis for environmental reconstructions in New Zealand and for qualitative climate change but they will never resolve issues of LGM temperature changes. Focus is now shifting to new proxies that may allow us to accurately quantify thermal changes. Fossil beetle research is one of the more promising lines. In the Awatere Valley in Marlborough in the north–east corner of the South Island, Marra et al. (2004) calculated a LGM summer cooling of 3.5–4 °C and a winter cooling of 4–5 °C from beetle fossils preserved in fluvial over-bank sediments along a fault trace. These values agree well with ELA estimates and SST calculations. The beetle fossils indicated the survival of a Nothofagus (Southern Beech) forest patch at this site at the LGM. Marra et al. (submitted) have also re-examined the well known Lyndon Stream site (Soons and Burrows, 1978) and concluded that no or insignificant cooling (<2 °C) occurred there at the LGM. The two sites are offset by several thousand years with the Lyndon stream representing the early part of the 'New Zealand LGM' (c. 24 ka), whereas the Awatere site represents the global LGM at 20–21 ka. Note, however, that on our limited data, the greatest glacial expansion in NZ is close to 24 ka not 21 ka (Suggate, 1990).

In summary, the currently available studies show that the LGM was complex with several glacial advances and retreats. Within the LGM there appears to have been milder and cooler climates. Even the association of cooler climates with the glacial stadia is not certain. During the deglaciation, there is a variety of evidence that climate events may have been triggered by hydrological changes rather than thermal forcing (e.g. Hellstrom et al., 1998;

Robinson et al., 2004). At a coarse scale the most likely control on precipitation in New Zealand is the strength of the westerly circulation and there is good evidence that westerly flow was enhanced during the LGM (Shulmeister et al., 2004). The possibility that increased snowfall, in addition to, or instead of thermal decline, contributed to glacial advances in New Zealand during the LGM must be entertained. Resolution of the nature of the LGM will give us a much better understanding of the nature of climate signal transfer from northern hemisphere ice sheets to New Zealand (if any!).

Stepping up one level from New Zealand, a critical long-term question is the reconciliation of relatively minor (no more than about 4 °C) thermal depression in NZ during the LGM and the apparently robust estimates of 8–12 °C temperature depression in SE Australia at that time (e.g. Barrows et al., 2002). Since Australia is upwind and up current of New Zealand, this requires any air mass travelling from Australia to be substantially modified before it reaches New Zealand. This implies that the Tasman Sea remained relatively warm (no more than about 4 °C cooler) during the LGM, which is consistent with the SST reconstructions. It further implies a very steep meridional gradient between the Tasman and Australia and a steep zonal gradient between the south Tasman and the Southern Ocean and the likely generation of intense low level depressions in the Tasman Sea.

Post-script

In response to interest both within and beyond the region, an Australasian INTIMATE (INTegration of Ice core, MArine and TErrestrial records) project has been initiated. The INTIMATE project is an originally European project focused on creating an event stratigraphy for the deglaciation in North Atlantic and adjacent areas. The extension of the project to Australasia is ultimately driven by the need to compare records on a global basis to look at issues like the apparent Northern/Southern Hemisphere climate see-saw. The focus for this group will extend from 30 to 8 ka so many of the issues raised in this paper will be examined. Resolution of these issues will also engage us in serious consideration of climate scale interactions between the Southern Ocean/Antarctica, the mid-latitudes and tropical phenomena such as ENSO and the monsoons. It should be an exciting few years ‘down under’.

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CANQUA (The Canadian Quaternary Association) and Quaternary Studies in Canada

Founded in 1975 and formally constituted in 1983, CANQUA joined INQUA shortly thereafter in order to host the XII INQUA Congress in Ottawa in 1987. CANQUA is devoted to Quaternary studies in Canada and includes a great variety of disciplines. Although many professional societies are experiencing a downward trend in membership, CANQUA membership has grown recently from 129 in the year 2000 to a high of 248 in 2003.

The main objectives of CANQUA are to promote Quaternary studies and facilitate interactions and communication among Canadian Quaternarists. Canadian Quaternary studies are promoted through the participation of the President of CANQUA in the Council of Presidents meetings organized through the Canadian Geoscience Council. Interactions are facilitated by (1) organizing a biennial conference, with the next one to be hosted by the University of Manitoba in June of 2005, (2) hosting a website at http://www.mun.ca/canqua/, (3) producing a semi-annual newsletter published in English and (4) operating a listserv for the discussion of Quaternary science. Originally envisioned as a mainly Canadian list, it has grown rapidly to include over 1100 subscribers from around the world. French and English may both be used in any communications and meetings of the association.

The most prominent Quaternary features of the Canadian landscape are those resulting from the pervasive influence of the Laurentide and Cordilleran ice sheets. The kinds of geomorphological features produced by glaciers and the processes by which they were formed have been a central focus for Canadian Quaternary geologists. Furthermore, the occurrence of glaciers in the Canadian High Arctic and in alpine regions of western Canada has led to a rich tradition of studying glacier dynamics both empirically and by modeling, with significant efforts dating from the formation of the Geological Survey of Canada in 1842.

As the second largest country by area and lapped by three oceans, Canadian national Quaternary research interests are broad and encompass the realms of ice, air, land and sea. The last Ice Age has been a natural focus given that Canada is a northern country that was almost entirely covered by the Laurentide and Cordilleran ice sheets during the last glacial maximum and that the Laurentide ice sheet was an important influence on global climate. With a diversity of landscapes, both glaciated and unglaciated, and seascapes, Canadian Quaternary research is a microcosm of Quaternary techniques and research questions as they apply to temperate, boreal, and arctic regions. And, Canadians have actively expanded their national interests internationally through a wide variety of collaborations and programs, especially in relation to marine environments and the ODP program.

Unlike some other nations that have one or more major, multidisciplinary institutions devoted to various aspects of the Quaternary, Canadian Quaternarists for the most part form more specialized, generally smaller groups. The largest and most prominent university-based Quaternary group in Canada is the PEARL lab directed by John Smol and focused on a wide range of paleolimnological and paleoclimatic questions, especially those related to the Arctic. John Smol and Bill Last also founded and continue to co-edit the highly successful Journal of Paleolimnology.

For those wishing to learn more about the Canadian Quaternary, the most comprehensive account and maps of Canadian Quaternary geology can be found in R.J. Fulton's *Quaternary Geology of Canada and Greenland* published by the Geological Survey of Canada in 1989 as part of the Decade of North American Geology Project series to mark the Centennial of The Geological Society of America. The response of plants to the waning of the Laurentide ice sheet is wonderfully described in J.C. Ritchie's award-winning book entitled *Postglacial Vegetation of Canada*, published by Cambridge University Press in 1987.

Les Cwynar
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South America—a regional member (The GEC Group)

South America is a Gondwanic plate surrounded by a large oceanic realm, in a region clearly influenced by the Antarctic Anticyclone. With a surface about 22 millon square kilometers, it has a large latitudinal extension, which reaches from 12°N to 56°S near the Antarctic Polar Circle. South America has a fairly simple geotectonic structure: a mountain belt in the west, a corridor of central lowlands and two regions of old terranes in the east. Patagonia as an exotic plate welded in the south. The climate is marked by the oscillation of the Intertropical Convergence Zone (ITCZ) and the southern influence. The biota forms the Neotropical realm, with African similarities and large differences to the Eurasian and North American ones.

In a first approach, the Andes can be described as a simple orogen formed by subduction of an oceanic plate below a continental margin (Fig. 1). On most of its length, the Andes are formed by a magmatic arc flanked by an oceanic trench to the west and basins and foreland to the east. It is a non-collisional mountain belt formed along a long-lived subduction system, which is still active. The sismicity of the Andes is higher in the segments where the Benioff zone is almost horizontal in Perú and Argentina.

The glaciation in Antarctica, a landmass that drifted to polar latitudes in the Miocene, was undoubtedly the decisive factor in the present cooling of the Earth. The southernmost Andes, located at a distance of less than 900 km from the Antarctic Peninsula, suffered the early influence of that new system and underwent several glaciations in Miocene and Pliocene times. The intermittent glacial pulses appear to be successively stronger until it occurred and extraordinary large event, named the "Great South American Glaciation" at IS 30 (about 1 million years B.P.). The most conspicuous dynamic processes in the Andes during the Quaternary were glacial ones, although physical weathering and mass movements were (and are at present) more important, particularly above 2500 m.a.s.l. The abundant fine-grained Tertiary rocks tend to produce a significant proportion of silt-sized material by those processes. Climates milder than the present one also occurred in the Quaternary, developing soils at high altitudes in Bolivia and Perú, reaching 4500 m.a.s.l. in some cases.

The central lowlands are the surficial expression of the Subandean foreland basin reaching from 10°N to 40°S. It is geologically divided into smaller sectors, which in general coincide with classical geographic names. Climatic changes in the lowlands are characterized by variations in humidity rather than variations in temperature: during global coolings the ITCZ tends to migrate to the north of the continent, producing dry climates in the south with development of dune fields and loess mantles in the Pampa and pedogenic phases in the Orinoco, and opposite scenarios during global warmings. The main components of the Quaternary geology in the lowlands are mega-fans, loess-paleosol sequences and dune fields. A particular mention is deserved by the large wetlands, 15 of which have areas larger than 10,000 km^2.

The major rivers of South America (Amazon, Orinoco and Paraná) are collectors of large hydrographic nets in the west as a result of the Mio-Pliocene elevation of the Andes and convey large amounts of water and sediments to the Atlantic ocean (Fig. 2). Approximately a half of the surface of the continent is formed by Paleozoic and Mesozoic rocks characterized by old landscapes, formed most of them during Tertiary. Quaternary processes are not conspicuous and not well known in such regions.

On the contrary of its geologic and climatic simplicity, South America is politically divided in 11 countries with no much academic contacts among them and frequent economical and political crises and obstacles. Hence, the development of the Quaternary science has been difficult and uneven in modern times. The beginning of Quaternary studies should be attributed to the great travellers of the XIX Century, Darwin, Humboldt, D'Orbigny and others. The local science produced the rare genius of Ameghino, a palaeontologist who described and classified the bulk of the Neotropical vertebrates and proposed a stratigraphic column still used today.

During the XX Century the Quaternary science developed in a complex way. Studies were made at local or provincial level in the first decades, with no significant integration among them. Some countries, as Argentina and Brazil, formed important and selfsustained communities of specialists along years, even developing national paradigms. Other countries owe their progress rather to studies made by foreign specialists visiting the region. These, in turn, resulted later easier to insert in the mainstream of the international science. The last 2 or 3 decades of the XX Century are characterized by a general improvement in integration and personal contacts of South American quaternarists among them and with foreign specialists. That change occurred largely thanks to the multiple activities of INQUA. The book by Clapperton "Quaternary Geology and Geomorphology of South America" is a milestone of that period.

At present, the number of Quaternarists really active in the region can be estimated in 200–300. A very loose simplification can indicate that Quaternary studies are dominated by geologists in Argentina and Venezuela, by geographers in Brazil and by

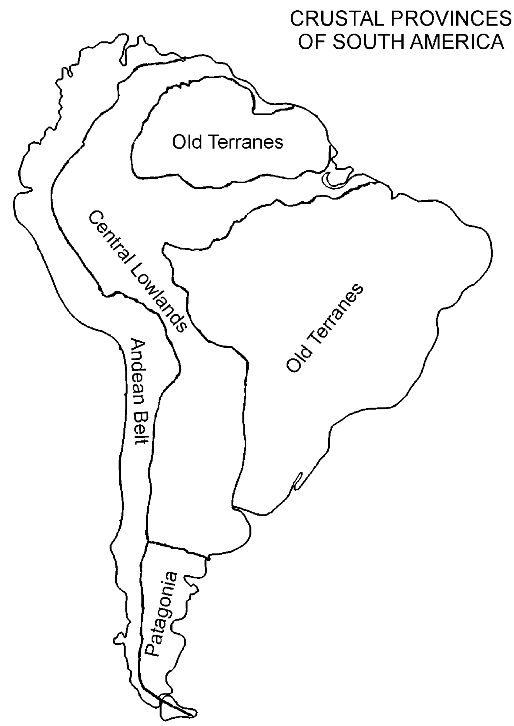

Fig. 1. Geotectonic scheme of South America.

palynologists in Colombia and the Pacific countries. Papers about our continent regularly appear in the principal international journals, and frequently special volumes on different issues are published abroad. Several of them, indeed, appeared on Quaternary International. The loess question has resulted the most prolific and interesting theme for the international literature. With respect to the local production, Brazil and Argentina have specific journals for Quaternary and Geomorphology, besides a regular production of papers and university thesis occurs in all countries. Frequently, such investigations reach high standards but have scarce diffusion.

The Grupo de Estudio del Cuaternario (GEC) was officially incorporated to INQUA as Regional Member South America by the International Council during the Reno Congress. It is a non-governmental organization (NGO) formed by a net of objectively active South American specialists dedicated to the promotion of Quaternary activities in the continent. The Group was formed in 1995, trying to evade bureaucratic and financial obstacles so frequent in official institutions. In the 10 years of existence, GEC has demonstrated the advantage to have a Regional Member in a region permanently hurt by economical and political turmoil, which tend to disorder the sensitive scientific fabric.

In fact, GEC is devised to complement (not to replace) official national agencies. Moreover, a national membership for small countries with a few specialists is really not practical. After the Field Meeting on Loess (Temperate and Tropical) in 1998, three international workshops were organised in Salto (Uruguay), Anillaco (Argentina) (Fig. 3) and Maringá (Brazil). Quaternary International volume 114 appeared in year 2004, as a result of these meetings. Workshops in Iquitos (Perú) and Santa Fe (Argentina) are foreseen for the years 2006 and 2007. All activities are focused to aleborate a Stratigraphic Correlation Table including all South American countries, to be finished in 2011. At present GEC is active in Argentina, Brazil, Chile, Uruguay and Venezuela; conversations for incorporation of active colleagues in Perú, Colombia and Bolivia are in progress.

Martín Iriondo (GEC Leader)

Book Review

U. Radtke, G. Schellmann, The Marine Quaternary of Barbados, Kölner Geographische Arbeiten, Heft 81, Geographisches Institut der Universität zu Köln, Germany, ISSN 0454-1294, 2004, 137 pp., (€30/$38; Postage: €2.5 Europe; €5 overseas).

This handsome volume is the result of over a decade of meticulous research by Gerhard Schellmann and Ulrich Radtke on aspects of the Quaternary sea-level history and coastal

Fig. 2. Moconá Falls, an exceptional feature in the Uruguay river channel at the Argentina–Brazil border.

Fig. 3. Assistants of the International Work Shop of GEC (Grupo de Estudio del Cuaternario), in Anillaco–Argentina, in 2002.

evolution of Barbados. The volume also stems directly from the fourth annual meeting of IGCP Project 437 (Coastal Environmental Change During Sea Level Highstands) held on Barbados in late 2002. Although the volume is based on the field excursion guide prepared for the IGCP conference, this volume is far more than a simple field guide.

The volume provides an excellent overview of the Quaternary geology and geomorphology of Barbados. The work is profusely illustrated with many colour photographs and figures. Following an introductory chapter outlining the general geotectonic setting of Barbados and its regional geographical characteristics, subsequent chapters describe the coral species present within the reef complexes and their modern equivalents, the overall nature of the coral reef terraces, the soils and associated weathering features developed on the reefal limestones and underlying Paleogene-Neogene basement, an evaluation of the pioneering and bench mark geochronological studies of Mesolella, and subsequent studies. The latter half of the volume presents a very detailed overview of the stratigraphical and geochronological studies of Schellmann and Radtke, principally in the application of electron spin resonance dating and comparisons with uranium-series dating. A huge amount of original data is presented in this section. The final chapter presents an extended summary of the principal research findings. The work is critical of the assumptions often made in studies of Late Quaternary sea-level changes.

This volume will be of wide appeal to researchers interested in unravelling the nature of sea-level changes based on the study of fossil corals. It represents a very valuable contribution to the literature. The volume may be purchased by writing directly to Ulrich Radtke at the following address: Geographisches Institut, Universität zu Köln, Albertus-Magnus-Platz, D-50923 Köln, Germany. Fax: 49 221 470 5124. E-mail: u.radtke@uni-koeln.de.

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International Workshop on Subaerially exposed continental shelves since the Middle Pleistocene climatic transition

A 10th Anniversary Celebration Event of the Department of Earth Sciences, The University of Hong Kong

Date: May 9–13, 2005
Venue: The University of Hong Kong, Hong Kong SAR, China
Organizer: Department of Earth Sciences, The University of Hong Kong

Sponsors: International Union for Quaternary Research (INQUA).
PAGES, International Geosphere–Biosphere Program (IGBP).
Dr. Stephen S.F. Hui Trust.
Department of Earth Sciences, The University of Hong Kong.

Background

This initial workshop forms part of a 3-year project (2004–2007) supported by INQUA through the Commission on Coastal & Marine Processes. The project is aimed at the study of terrestrial deposits in sub-aerially exposed continental shelves since the Middle Pleistocene climatic transition (MIS 13). An important focus is the role of sub-aerially exposed continental shelves in carbon storage and the likely contribution of greenhouse gases into the atmosphere. Abstracts on all aspects of continental shelf sciences are welcomed. Both oral papers and poster papers are acceptable. Each participant is encouraged to present one oral paper and one poster paper.

Registration

Registration fee will cover the cost of attendance, workshop materials, refreshment breaks, lunches, the reception, the full-day field excursion and the conference dinner.

Fee before March 1, 2005 HK$ 1200 (US$155)

Fee after March 1, 2005 HK$ 1350 (US$175)

The registration fee for accompanying spouse inclusive of the reception, the full-day field excursion and the conference dinner is HK$ 700 (US$90). Payment should be made either in HK$ or US$ by overseas bankdraft payable to 'The University of Hong Kong'.

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11th International Conference on Luminescence and Electron Spin Resonance Dating

University of Cologne, Germany
25–29 July 2005

The University of Cologne invites to the 11*th International Conference on Luminescence and Electron Spin Resonance Dating*. LED 2005 will bring together different experts in the field of trapped charge dating from all around the world. The topics will range from fundamental studies of the physical basics of trapped charge dating, through advances in equipment technology and analytic procedures, to applications in dating Quaternary deposits and archaeological material. A few invited lectures will provide an overview on the main topics. A half-day workshop preceding the conference is planed for Sunday, July 24th. This workshop will focus on basic problems involved with the application of trapped charge dating and addresses to non-specialists and students.

Persons interested in attending the conference are kindly asked to contact the organisers (U. Radtke, Department of Geography, University of Cologne: E-mail: LED2005@uni-koeln.de; fax: +49 221 470 5124). Deadline for registration is 1st of March 2005. We recommend the conference web-page at http://www.uni-koeln.de/LED2005 for regular up-dates and links.

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The new editors of Quaternary Perspectives. Frank Preusser (left) and Christian Schlüchter (right) of Bern University.