Photograph of Bacolor township, Pinatubo area, 1995. This colonial-age town was inundated by lahars in October 1995, just prior to the Pinatubo Lahar workshop and more than 4 years after eruption.

COMMISSION ON VOLCANOGENIC SEDIMENTS

CVS Newsletter #17

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CVS Co-leaders '99

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GREETINGS AND INTRODUCTION

The Cape Town meeting of IAVCEI offered the opportunity for attendees to designate a couple of CVS members to succeed Nancy Riggs and Peter Ballance as co-leaders of the Commission. As a result, we (Ian and James) will be handling the CVS newsletter and web page for the next couple of years. After an undeniably slow start, we will aim to produce a newsletter every ½ to ¾ year, and would be happy to receive comments or (better yet) contributions at any time. Got an event to publicize? Have you read a good volcaniclastic books recently? Any recent journal articles that bear general CVS discussion?

In this issue:

In the lead-up to y2k we have a promising volcanological 1999, with the major IUGG meeting in Birmingham and 2 associated CVS-linked field trips, each described later in this newsletter. For 2000, there is a field workshop in Baja California (see below), the General Assembly in Bali, Indonesia, and no doubt other meetings that we will be publicizing later this year. And, volcanological sedimentologists, don't forget the occasional sedimentology meetings - see the advertisement for the International Association of Sedimentologists 1999 European Regional Meeting in Copenhagen.

Also in this issue are reports back from previous meetings, symposia and field trips, and a discussion piece on what may or may not be meant by the term "peperite". A new "feature" in this newsletter is reports from various volcaniclastic study groups or sites, with an initial contribution from Vern Manville (Taupo Volcanic Zone studies).

It would greatly enhance communication within CVS if all members who have access to email would send a message to james.white@stonebow.otago.ac.nz. The addresses will be compiled, distributed via email, entered onto the CVS web page, and attached to a future newsletter. Email can also be used for interim communication between newsletters. ***So please send along your email message***, and if there are any changes to other aspects of your contact details, send those along as well. Assuming a good response, we will add an updated membership list to a later newsletter.

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Peperite Session: IVC, Cape Town, South Africa, 1998

Contributed by Jorge Vazquez, University of California, Los Angeles, jvazquez@ess.ucla.edu

Peperite was the subject of a special session during the 1998 IAVCEI meeting held at University of Cape Town, South Africa. The elegant campus was a wonderful venue to host the meeting and the Cape Town environs offered participants rich culture and spectacular geology. The session served as a forum for discussion of the processes and products associated with magma-sediment mixing, and the implications of these mixtures for processes of explosive volcanism. Because of the relationship between peperites and explosive volcanism, the session was co-sponsored by the Commission on Explosive Volcanism in addition to the CVS.

The session included oral presentations and posters that described mafic to felsic peperites associated with a variety of volcanic products, including lavas, sills, domes, and even ignimbrite. Cathy Busby and Ian Skilling chaired the session and did a superb job managing the schedule. One of the biggest buzzes amongst the session participants regarded the basic definition of peperite. This question was prompted by the eye-opening review of the type-peperite locality in France by DeGoer, Vincent and Camus at the beginning of the session. This question was also prompted by the wide variety of volcanogenic mixtures that were designated peperite, regardless of their mode of origin, by many participants. Ironically, the type-locality of peperite is made up of subaerial hydromagmatic deposits that would not fall into the definition of peperite used by many volcanologists. In the past, peperite has been associated with dynamic, thermally-induced mixing between magma and wet sediments, but the peperite definition was extended by many participants to include deposits formed by other mixing mechanisms, such subaqueous dome-collapse.

Most of the presentations dealt with individual examples of peperites from all over the world and included some very interesting and unique examples. Ian Skilling showed some very nice SEM images of peperite and underscored the utility of this technique for analyzing samples at an unsurpassed level of detail. Sharon Allen and Ray Cas described mixing between the Kos Plateau Tuff and unconsolidated mud and presented spectacular photos of tuff-sediment interaction.

In the end, the session was a smashing success and allowed participants to reevaluate many of the basic elements of peperite formation. A nice aspect of the session was the significant participation by students. All came away from the session satisfied and stimulated by the discussion and personal interaction that makes special sessions, and meetings in general, enjoyable. We all look forward to future peperite sessions!

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PEPERITE: WHAT IS IT? HOW DO WE RECOGNISE IT? WHY STUDY IT?

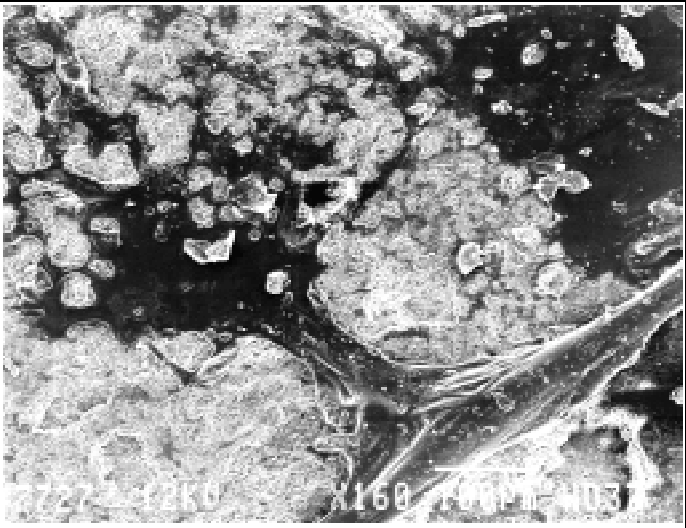
By Ian Skilling, with contributions from James White and Jocelyn McPhie

What is peperite?

At the peperite symposium, convened by Ian Skilling and Cathy Busby at the IVC in Cape Town in July 1998, it was noted that the term "peperite" was understood by some to refer to any mixture of juvenile magma with sediment. Such mixtures can form by several different processes and it seemed desirable to set forth a concise definition of the term "peperite" in a broad genetic sense, and in the sense in which it is (and has been) most widely understood. Following some . . . discussion, I and James and Jocelyn came up with the following:

Peperite is a genetic term applied to a rock formed essentially in situ by disintegration of magma intruding and mingling with unconsolidated or poorly consolidated, typically wet sediments. The term also refers to similar mixtures generated by similar processes at the contacts of lavas and hot pyroclastic deposits with such sediments

Definitions (especially genetic ones) are rarely universally acceptable, but we hope that this definition is sufficiently flexible to be clearly applied even in the case of "problem rocks". The term "sediment" refers to any unconsolidated or poorly consolidated particulate material. This is usually wet, and in fact fluidised water/steam may be essential to allow large volumes of magma and sediment to intimately mix (Kokelaar, 1982). We can't at this stage exclude very local mingling with dry sediments, at the base of lava flows on aeolian sand for example, though the processes must be different. We felt it important to exclude magma-sediment mixtures formed from vitric or magma pyroclasts which have been transported through air or water prior to deposition into wet sediments (e.g. base surge or airfall into wet sediments). The definition implies SIMULTANEOUS magma fragmentation and intrusion into sediment and therefore excludes these processes. We also wanted to exclude any erupted (explosive or effusive) magma- sediment mixtures (and their resedimented equivalents) since, although these mixtures may have been generated by sub-surface "peperite processes", the original peperite-forming textures would be destroyed to varying degrees. The phrase "essentially in situ" is also intended to exclude magma-sediment mixtures formed after significant SUB-SURFACE movement (including explosive) of the mix away from the locus of INITIAL peperite generation. One problem with this of course is that some peperites may form within a "peperitising" front that moves ahead of magma as it intrudes into wet sediment, and would not have a single locus of peperite formation.



Degassed basalt (dark) mingling with silt (pale), Welgesien, South Africa. A dendritic tendril of basalt is fragmented at its end by vesiculation (and fluidisation?) of the sediment host.

The second sentence of the definition refers to peperites formed by simultaneous magma fragmentation and mingling with sediment at the base of lava flows and hot pyroclastic deposits. Although not explicit in the definition, we want to exclude mixing textures generated EXCLUSIVELY by loading, and rocks formed EXCLUSIVELY by the ploughing into and deformation of sediments by overriding pyroclastic flows or lava flows (e.g. Duffield et al., 1986). We suggest that the processes that generate such magma-sediment mixtures are sufficiently different from those of peperites (used in the sense discussed above) that they should be described using other terms.

How do we recognise peperite?

What criteria can we use to distinguish peperite, in the sense used above, from similar-looking mixtures formed by other processes? In some cases it will not be easy (especially since the nature of peperite- forming processes are poorly understood), but the crucial feature to try to recognise is any evidence for simultaneous magma fragmentation and mingling with sediment. Magma-sediment mixtures formed by pyroclast deposition into wet sediments could be difficult to distinguish, especially if the transport distance in air or water was short, pyroclast viscosity was low and depositional rate was high. In these cases within-sediment mixing to form peperite may take place after deposition, but this would be very local. The palaeoenvironment of the host sediment, lithofacies associations, the presence of certain structures, such as impact sags, and the absence of large volumes of highly convolute/intricate mixing textures could be used to distinguish these mixtures from peperites.

Erupted magma-sediment mixtures and their resedimented equivalents could easily be distinguished from "in situ" peperite, because they will not display intrusive characteristics on the scale of the unit or body. Subsurface-transported peperite is clearly more akin to peperite in the sense we use here as it is part of a continuum from in situ peperite, with variable degrees of destruction of the initial peperite texture. Exactly how far peperite mixes can travel within subsurface sediments from the site of initial magma fragmentation, and how their textures may differ from "essentially in situ" peperite is unclear. The possibility of peperites forming on the move (within a front ahead of magma intruding into wet sediments) further complicates this distinction!

Probably the most useful single criterion for recognizing peperite is the presence of coherent bodies of congealed magma (lava, dikes, sills, etc.) in gradational relationships with the peperite. Highly irregular dike margins, apophyses and tendrils from the bases of lava flows, and inclusion of bodies of sediment within dikes and lavas near their contacts with peperite all offer evidence of essentially *in situ* melt fragmentation and mixing. At large scales, large outcrops and good exposure may be required to unambiguously distinguish peperite from other volcaniclastic mixtures.

Why study peperites?

There are several reasons why the study of peperite is important. Firstly, peperites are common within many mixed volcanic-sedimentary sequences where they demonstrate magmatic and sedimentary contemporaneity (important for stratabound mineralization studies) and can also be used to distinguish lava flows/pyroclastic eruptives from sills.

Call for peperite papers

Ian Skilling, James White and Jocelyn McPhie invite submissions to a proposed special issue of the *Journal of Volcanology and Geothermal Research* devoted to peperites. We are particularly keen to see papers which address the ways in which peperites form, implications of their formation for other aspects of magma-water interactions in natural environments, and thermodynamic aspects of peperite formation. Please contact Ian Skilling with your manuscript proposals (see newsletter address).

Secondly, we can be sure that magma fragmentation has, in the vast majority of peperites, taken place under wet (water or steam) conditions. Magma-water interaction is often inferred from (palaeo)environmental setting (not always unequivocal), eruption and emplacement process (difficult, except for some such as base surges) and vitriclast size and morphology (perhaps the most equivocal). Peperites are particularly useful for the study of vitriclast morphology and fragmentation processes during magma-water interaction (though the differences between interaction with clear water and sediment-laden water are not well understood; White, 1996).

Similarly, in peperites a record of the behaviour of the "coolant" during magma-water interaction may be uniquely preserved by features such as vesiculated sediment, flow alignment of sediment or juvenile grains, flow folding, destruction of laminae and bedding, grain size sorting along magma-sediment contacts, etc.

Magma-water interaction is sometimes highly explosive and its study clearly has implications for volcanic hazards. Peperite study is vital for an understanding of the variations in explosivity of these processes. Some peperites (micro-globular peperites) have been interpreted as arrested FCI's (Busby-Spera and White, 1987), whilst others clearly have no link to violently explosive processes. We must be aware that although some peperites may represent precursors to explosive interactions, they are nevertheless at best *failed* explosions. Despite this shortcoming, peperites can provide us with the best field evidence available for the initial processes of magma fragmentation during interaction with water, particularly for non-explosive interactions.

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Duffield et al. (1986) Deformation of poorly consolidated sediment during shallow emplacement of a basalt sill, Coso Range, California. Bull. Volc., 48, 97-107.

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White, JDL (1996) Impure coolants and interaction dynamics of phreatomagmatic eruptions J. Volc. Geotherm. Res., 74, 155-170.

Comments or disagreements? Please send any further discussion to the newsletter editors!

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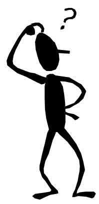

CURRENT RESEARCH ON YOUNG VOLCANICLASTIC SEDIMENTS, TAUPO VOLCANIC ZONE, NEW ZEALAND

Contributed by Vern Manville
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Over the past several years vigorous research programmes have been established which are addressing the hazards and processes of sedimentation following volcanic eruptions at many scales in the Taupo Volcanic Zone.

The 300 km long Taupo Volcanic Zone (TVZ) is an area of intense Quaternary silicic volcanism associated with rapid extension and thinning of continental crust in the central North Island of New Zealand. The TVZ is characterised by relatively small, but very frequent, caldera-forming eruptions. More than 34 such ignimbrite-emplacing events have occurred since 1.6 Ma from 8 relatively short-lived, nested, and/or overlapping volcanic centres aligned along a north-east striking structural trend. In terms of life span, erupted volumes, and area the TVZ is comparable to the North American Yellowstone system. Large lakes developed in calderas and fault-grabens dominate local hydrologic systems, their boundaries and outlet channels shifting in response to eruptive activity. Thick sequences of intercalated volcanic and lacustrine units dating back to 0.6 Ma reflect the intermittent nature of large-scale eruptive activity within the TVZ (Smith 1993). This environment, with its record of frequent large-scale caldera-forming eruptions since 65 ka, is a superb natural laboratory in which to investigate the interactions between explosive volcanism and landscape development, as mediated by process of erosion and resedimentation.

Research, particularly in a programme which has involved the Institute of Geological and Nuclear Sciences (GNS) and University of Otago, has so far been concentrated on the aftermath of the most recent large eruptions from a number of volcanoes and spanning a range of styles and magnitudes. These include:

- The minor (0.1 km^3) phreatomagmatic and subplinian 1995-96 eruptions from the Ruapehu andesitic stratovolcano at the southern end of the TVZ.
- The 1886 Tarawera eruption, a 1 km^3 basaltic plinian event from a resurgent rhyolite dome complex within the caldera structure of the Okataina Volcanic Centre.
- The 7 km^3 rhyolitic 700a Kaharoa eruption in the Okataina Volcanic Centre.
- The 105 km^3 (eruptive volume) ignimbrite-emplacing and caldera-forming 181 AD eruption from the Taupo rhyolitic caldera.
- The c. 100 km^3 64 ka Rotoiti eruption from the Okataina Volcanic Centre.

Studies during and following the 1995-96 eruptions of Ruapehu have documented the complex interplay between tephra, liquid water, and frozen water (snow and ice), in a seasonally changing alpine environment. Work by JDL White (Otago University), KA Hodgson (Lincoln University) and V Manville has focussed on the remobilisation of pyroclastic material and highlighted the importance of rain-triggered lahars, a previously unrecognised hazard at this temperate zone volcano. Primary lahars generated by explosive eruptions through the Crater Lake, and their downstream transformations, have been the subject of comprehensive analysis by researchers at Massey university including SJ Cronin, VE Neall, J LeCointre and AS Palmer. Meanwhile, research led by BF Houghton (IGNS) has investigated the nature of the unusual granular snow, ice and tephra lahars produced by the interaction of ejected lake water with snow. These lahars, which flowed through the Whakapapa skifield, presented the most immediate threat to human life.

Fieldwork at Tarawera (JDL White, BF Houghton, MD Rosenberg, and B Drieburg) has shown the importance of tephra fall deposit grain-size on the timing and severity of remobilisation processes. Erosion was most severe in the relatively fine-grained phreatomagmatic Rotomahana Mud deposits, and least effective in the coarse basaltic scoria fall units. The outlet to Lake Tarawera was temporarily blocked by a tephra barrier impounding a substantial excess volume of water which was released in 1904, eighteen years after the eruption, and caused severe flooding for > 50 km downstream to the coast. This event triggered a renewed phase of incision of 1886 fall and older deposits in proximal areas by scouring the trunk stream, lowering local base levels, and hence rejuvenating tributaries.

Research at Tarawera related to the 700a Kaharoa eruption (KA Hodgson) has been focussed on the post-eruptive response in the Tarawera River Valley. After an initial phase of remobilisation of primary pyroclastic material, catastrophic breaching of a barrier at the outlet to Lake Tarawera triggered a breakout flood estimated to exceed 1×10^5

m^3/s in peak discharge. The exact sequence of events and the nature and origin of the blockage remains uncertain, but numerous huge flood boulders strewn downstream of the outlet testify to the magnitude of the resulting flood.

Modern Lake Taupo owes much of its present form to caldera collapse during the 26.5 ka Oruanui eruption, and faulting and warping on regional structures. With an area of 620 km^2 and a volume of ~ 60 km^3 it is the largest lake in New Zealand and the largest body of freshwater in Australasia. Emplacement of the 35 km^3 Taupo ignimbrite over an area of 20 000 km^2 radially disposed about the vent wiped out all vegetation, buried the land surface beneath a layer of pyroclastic material, and destroyed existing hydrologic networks by infilling valleys and depressions with up to 60 m of loose, unconsolidated pumiceous material. The lake basin was essentially emptied during the eruption, with the remnants draining into the sub-basinal collapse structure and the outlet being choked by pyroclastic debris. Research on landscape responses to this event has been divided into two parts. Firstly, the intracaldera response to rising lake levels has been documented by M Ort, NR Riggs (both University of Northern Arizona), JDL White, and R Clarkson (Otago University), with research focusing on the relative roles of depositional environment energy and rates of transgression in determining the lithofacies developed. The extracaldera story has been concerned with the impact of the eruption on the six major river systems that drain the central volcanic plateau and head in the area impacted by ignimbrite. V Manville has investigated the effects on the Waikato River that drains Lake Taupo. Extensive fieldwork has identified a number of different downstream sub-environments, including major supra-ignimbrite lakes developed in temporarily blocked drainages. A number of distinct stages in the re-establishment, evolution, and stabilisation of drainage systems and river networks have also been identified. Whilst river systems reformed, the intracaldera lake refilled to ~ 34m above its modern level before breaching its barrier near the modern outlet. This triggered the catastrophic release of c. 20 km^3 of water as a breakout flood whose effects can be traced for over 230 km downstream. A buried forest is being used in an attempt to constrain the interval between the eruption and the outbreak flood using dendrochronology. The impact of the Taupo eruption on rivers in the Hawkes Bay region is currently the subject of PhD research by B Segschneider (Otago University). This will provide information on river systems uncomplicated by the temporary storage of water in lakes and their subsequent outbreak floods. One major catchment area, for the Wanganui River, remains to be addressed (applications for PhD study by A-level students welcomed! JDLW).

Notice of intent to convene symposium at the 2000 IAVCEI General Assembly, Bali, Indonesia

Ian Skilling and James White have proposed a symposium on Surtseyan volcanism (eruptive, primary depositional, and reworking and redeposition processes) to be held at the General Assembly at Bali. It is of course very early to be considering presentations to be made 18 months hence, but this note signals the likely availability of this session and solicits any early expressions of interest.

Post-eruptive resedimentation in the aftermath of the landscape-forming 64 ka Rotoiti eruption from the Okataina Volcanic Centre has been conducted by PhD student B Luedtke (Otago University). Initial results suggest that most activity was confined to relatively deep and narrow canyon systems incised through the pyroclastic fan deposits at an early stage. Early phreatic explosions, developing at the top of thick ignimbrite, clearly played a significant, though as yet incompletely understood, role in drainage re-establishment.

During the course of research on specific events and products of volcaniclastic sedimentation, a number of topics have arisen which warrant further study. These have included the saturation behaviour of pumice, and the depositional mechanisms of stratified bouldery gravels associated with lake breakout floods. Pumice is an unusual geological material, being a highly vesiculated foam of rhyolitic glass. Its most noticeable features in the sedimentary environment are its low density, often lower than that of water giving it the ability to float, and its variable density, achieved by waterlogging of a proportion of the pore space. Empirical saturation experiments on samples of 181 AD pumice, and theoretical considerations using the mathematical analogue of thermal conduction, show that the time to sink for pumice clasts is related to the square of the clast radius. Field examples of lacustrine pumice facies show unusual features that can be directly attributed to the saturation behaviour of pumice. Stratified bouldery gravels, in which outsize clasts are supported in a matrix of crudely stratified, poorly sorted coarse sand, are a common feature associated with lake breakout floods at New Zealand calderas. An initial depositional model suggests that such bimodal sediments result from deposition from a sediment-laden, hyperconcentrated flow, by two different mechanisms. The coarsest particles sediment due to a fall in flow competence (a measure of the sediment transporting ability of a flow as expressed by the largest particles that it can move). Simultaneously, the matrix material is deposited due to a fall in flow capacity (a measure of the sediment transporting ability of a flow as expressed by the total volume of material that can be moved). This model has important implications for the consideration of sediment-water mixtures such as lahars and jökulhlaups, as well as other particulate granular dispersions, such as turbidity currents and pyroclastic flows.

Future research will pursue a number of projects. A major aim is to address the effects of the landscape-forming 26.5 ka Oruanui (1200 km^3) on the central North Island of New Zealand. This event essentially reconfigured lake and river systems in the central TVZ into their present form, as well as causing major fluvial aggradation and avulsions hundreds of km downstream. An added complication with this event is its coincidence with the climax of the Last Glacial Stadial, and disentangling the relative signals of climate from volcaniclastic oversupply will be a real challenge. Another line of projected work will seek to improve understanding and quantification of hydrologic hazards at New Zealand's volcanoes using computer-based models.

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PRECONFERENCE FIELD WORKSHOP TO SOUTH ICELAND

July 12-17, 1999

(does not include arrival and departure days in Iceland)

Tentative schedule

July 12. Reykjavík – Skaftafell/Skeidarársandur/Vatnajökull eruption.
We will drive along the southern coast of Iceland to Skaftafell, SE Iceland, where we will spend the next two nights. Thick volcanigenic and glaciofluvial sediments were deposited on Skeidarársandur during the great jökulhlaup (outburst flood) event that followed the 1996 eruption in Vatnajökull. We will study these sediments in detail, both the distal part out on the sandur plain and the proximal deposits at the glacier margin. Furthermore, we will examine volcaniclastic deposits from Öræfajökull cone volcano (the highest mountain in Iceland (2119 m), which destroyed large part of the settlement in this area in 1362 AD.

Sponsored by the IAVCEI Commission on Volcanogenic Sedimentation, in conjunction with the July 1998 IUGG meeting

July 13. Skaftafell - Skeidarársandur. See above.

July 14. Skaftafell - Laki (Lakagígar) - Kirkjubæjarklaustur.
From Skaftafell we will drive to Lakagígar and visit the numerous volcanic cones and fissures from which the Skaftáreldahraun originated in 1783; one of the largest Holocene lava flow in the world (ca. 560 km^2). Over one-fifth of the Icelandic population is thought to have died in the years following this devastating eruption which caused abnormal sunsets over large part of Europe and climatic cooling during the following years.

July 15. Kirkjubæjarklaustur - Katla - Eldgjá - Landmannalaugar.
From our overnight accommodation at Kirkjubæjarklaustur we will drive the scenic mountain road to Landmannalaugar. On our way we will see Myrdalsjökull glacier under which the volcano Katla is located. Major jökulhlaups originate from underneath the ice cap during eruptions in Katla, and the great sandur plains in front of the glacier manifest the enormous forces released by such outburst floods. It has been hypothesized that the Vedde Ash layer which has been found over large area in the North Atlantic region originated from Katla. We will then visit the fissures of the Eldgjá eruption in 934 AD which produced great amounts of tephra and lava during its course. We will take a closer look at the hyaloclastites and breccias that are abundant in the walls of Eldgjá. We will end our day in Landmannalaugar area which lies in the midst of the Torfajökull central volcano. This is the largest rhyolitic region in Iceland and includes great variety of rock formations and volcaniclastics.

July 16. Landmannalaugar - Hekla - southern lowlands.
We will drive the desert-like landscape on Landmannaleid over to the Hekla central volcano. Hekla is one of the most active volcanoes in Iceland and erupted last in 1991. We will examine its great tephra deposits which some are over 10 m thick. The most extensive of these tephra layers form very important time-stratigraphic markers (e.g. H3, H4, and H5) as they are found over large parts of Iceland as well as in northern Europe (Ireland, Scotland, Germany).

July 17. Southern lowlands - Thingvellir - Langjökull - Borgarfjördur - Reykjavík.
At Thingvellir National Park (the site of the old Icelandic parliament) we observe the spectacular faulting at the boundary between the North American and Eurasian plates. From there we will drive the Kaldidalur highland track close to some of the most prominent shield volcanoes (Ok, Skjaldbreidur) and hyaloclastite table mountains (Eiríksjökull) in Iceland. After a quick stop at Langjökull glacier we will continue to Borgarfjördur, W Iceland, where we will study welded tuff flows and other Pliocene volcaniclastites. Finally, we will end our trip in Reykjavík.

Accommodation in mountain huts or sleeping bag accommodation
Approximate price: $970. (This price does not include airfare to and from Iceland!)

Maximum number of participants: 35
Minimum number of participants: 10

Field trip leaders: Óskar Knudsen, Andy Russell, and Jórunn Hardardóttir

Please e-mail Jórunn Hardardóttir to express interest or for further information: jorunnha@raunvis.hi.is

The schedule is subject to change, mainly due to snow and road conditions.

CEV Field Workshop July 7-18, 1999, UK (w/ IUGG 99)

INSIDE SILICIC CALDERAS (Snowdon, Scafell and Glencoe): interactions of caldera volcano development, tectonism and hydrovolcanism.

This will be a 10-day field-based discussion workshop, to run before the July IUGG at Birmingham, England. Leaders: Mike Branney and Peter Kokelaar.

The workshop will visit 3 contrasting caldera volcanoes: Snowdon in Wales, Scafell in the English Lake District, and Glencoe in Scotland. The volcanoes have been uplifted and deeply eroded, beautifully exposing internal structure, caldera faults, conduits, intracaldera sediments, silicic domes, peperitic intrusions, ignimbrite fills, and underlying caldera floors such as are generally obscured at modern calderas. Participants will examine contrasting products and collapse geometries in shallow marine, lacustrine, and subaerial/fluvial settings.

Discussion themes of the workshop will include (1) the nature and controls of contrasting styles of collapse; (2) the discrimination of tectonic influences; (3) hydrovolcanism in flooded calderas; (4) the controls on emplacement of high grade, and locally lava-like ignimbrite lithofacies in intracaldera settings; and (5) roles played by intracaldera intrusions.

The cost will be about £500 (US$800), which will cover return transport to and from Birmingham, all hotel accommodation, breakfasts, evening meals, and field guidebook. The workshop will involve strenuous walking over rough terrain in some of the most scenic parts of Britain, as well as informal evening seminars.

Maximum number of participants: 25.

If you would like to participate, please notify Mike Branney, at the Geology Department, Leicester University, University Road, Leicester LE1 7RH, UK. Email: mjb26@le.ac.uk FAX: 44 116252 3918. State your particular field of interest and any suggested topics for discussion/presentation. Registration and full payment (in pounds Sterling) will be due December 10, 1998. Dr Michael J Branney, mjb26@le.ac.uk Department of Geology, University of Leicester, University Road, Leicester LE1 7RH United Kingdom. Tel: (0)116 2523647 FAX (0) 116 252 3918

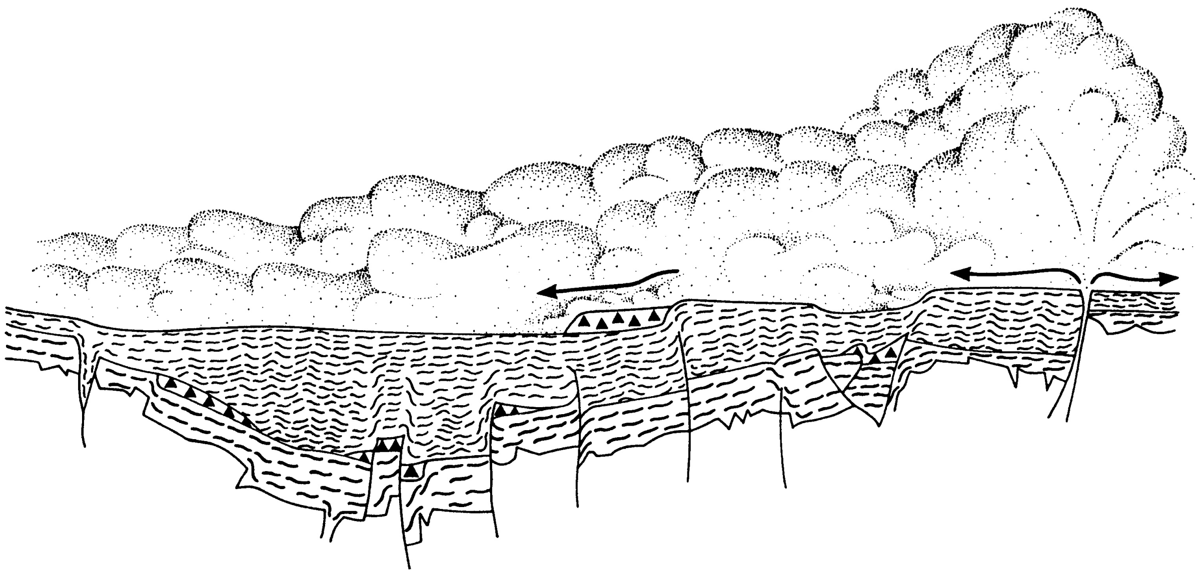

Image from Branney and Kokelaar 1994, GSA Bulletin 106, 507-530

PRELIMINARY ANNOUNCEMENT AND CALL FOR LETTERS OF INTENT:
IAVCEI Field Workshop on VOLCANIC AND TECTONIC PROCESSES IN ISLAND ARCS

Recent years have seen major advances in the understanding of modern oceanic arc systems. These studies mainly give a two-dimensional (map) view of eruptive centers, basins, faults and so on. Although geophysical and coring studies yield some insights into the third dimension, these are generally widely spaced, and uncertainty remains about the specific nature and origin of many deposits. Detailed outcrop studies of uplifted, dissected and well-exposed oceanic arcs are required to complement the understanding gained from modern systems. We propose a field workshop that will bring together researchers in modern and ancient island arc settings, by examining an exceptionally well-exposed and well-preserved island arc terrane in Mexico.

Cosponsored by the
Commission on **E**xplosive **V**olcanism &
Commission on **V**olcanogenic **S**ediments

Baja California, Mexico
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The Cretaceous Alisitos arc in Baja California is superbly exposed and largely nonmetamorphosed to weakly metamorphosed. It provides undisrupted, 4 km thick cross-sectional views of island arc volcanoes and their intrusions. This permits observations of the structural controls on magmatism and basin formation. Both volcano-bounded and fault-bounded basins will be examined. Lateral continuity of exposures also allows examination of vent-proximal-to-distal assemblages around a variety of types of eruptive centers, including nonmarine and marine calderas, as well as smaller centers. These include subaqueous pyroclastic flow deposits, inferred to have ranged from cold to very hot during their emplacement. Other features to be examined include a classic peperite locality, deepwater silicic fire fountain accumulations, and a 10 km^3 debris-avalanche shed into deep water by sector collapse due to dike push.

Workshop participants will fly to Los Angeles, and be transported into Mexico in four-wheel-drive vehicles, to camp out off road for seven days. Participants must be able to do day-long foot traverses of 10-15 miles. Daytime temperatures will be pleasant, nights cool, and the desert will be in full bloom. Winter rainstorms will have ended, but the canyons will still have water, necessitating much wading and some swimming to access outcrops (sports sandals essential).

We are also considering having a one- or two- day meeting before the field trip, for participants to informally present current research results, perhaps in Santa Barbara (2 hours from the LA airport) or en route to the field in Ensenada (Baja California).

PLEASE INDICATE YOUR INTEREST IN WRITING TO CATHY BUSBY, AS SOON AS POSSIBLE. I will use these letters to seek partial financial support of the field workshop, which will otherwise cost about $700/participant (excluding the possible night or two in Santa Barbara or Ensenada).

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IVC EXCURSION TO THE KAROO VOLCANIC AND INTRUSIVE ROCKS, EASTERN CAPE PROVINCE, SOUTH AFRICA

Contributed by David Elliot, Byrd Polar Research Center, Ohio State University, elliot.1@osu.edu

As part of the IVC meeting in Cape Town , July 1998, a seven-day field excursion to examine Karoo dolerites, basalts and volcaniclastics rocks of the Eastern Cape Province was organised by Prof. J.S. Marsh and Dr I. Skilling, both of Rhodes University, Grahamstown.

The excursion started in Grahamstown and travelled as far north as the village of Rhodes, close to the Lesotho border. Of particular interest were the stops to examine the structures and rocks resulting from hydrovolcanism associated with Karoo magmatic activity. Diatreme-like structures, lacking juvenile material, cut the Elliot and Clarens Formations, which underlie the Jurassic basalts; these are doubtless phreatic vents related to emplacement of dolerite sills at relatively shallow depth and the consequent heating of groundwaters. Phreatomagmatic vents also cut the sedimentary formations and the lowest basalts. Such vents are well displayed by the Welgesien and Noordhoek structures, northeast of Molteno. The lapilli-tuffs and tuff-breccias at Welgesien include abundant sedimentary clasts and mineral grains, juvenile basaltic fragments, and peperite clasts, all of which provide convincing evidence for an origin by magma-water interaction. Noordhoek, a much larger structure, displays complex facies relationships in the tuff-breccias and includes megaclasts (as much as 150m+ long) of stratigraphically intact Clarens Formation and Karoo basalt. Tuff-breccias and lapilli -tuffs, and tuffs of base surge origin, also occur interbedded low in the basalt sequence; the source for the laharic deposits is not known, but the base surge deposits at Tafelkop could be related to the adjacent Welgesien structure.

An interesting and unusual locality at Sterkspruit, between Barkly East and Rhodes, exposes nearly 100m of unbedded breccia which contains cored bombs and abundant round basaltic lapilli 1 to 2 cm across, suggesting Strombolian activity. Setting aside the Sterkspruit locality, the scattered but widespread evidence for hydrovolcanism documents the initial emplacement of Karoo magma and its interaction with groundwater; the lack of such rocks higher in the section obviously suggests that either the rate of magma supply increased and sealed off the conduit walls or the recharge was insufficient to maintain hydrovolcanic activity. This field excursion provided a fine opportunity to examine a little known aspect of Karoo magmatic activity.

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IVC EXCURSION TO SOUTHERN ETENDEKA VOLCANISM, NORTHWESTERN NAMIBIA

International Volcanological Congress - Cape Town, South Africa
Field Excursion C4, July 17-25, 1998

Contributor: Cathy Busby, Geological Sciences, University of California-Santa Barbara, cathy@magic.ucsb.edu

This trip focused on the vast volcanic outpouring that immediately preceded the opening of the South Atlantic Ocean along the Tristan da Cunha hot spot, at about 132 Ma. There are no modern analogues to these very large-volume, high-temperature volcanic floods, so their eruptive and transport-depositional behavior remains highly controversial. The Namib Desert is the oldest desert on Earth, probably dating from the beginning of the Mesozoic, and sand dunes were perfectly fossilized in a largely undisrupted state within the fluidal lava flows. This provides a unique opportunity to examine complete dunes in the rock record. Outstanding exposure of continental rift intrusive complexes completes the story.

Ten leader/driver/guides took 19 delegates offroad in the Namib desert for seven nights. We traveled in ten 4WD vehicles, moving camp nearly every night, and we commonly traveled all day without encountering another party. Only one stop was made midway to refuel vehicles and refill the water jugs, and all food and drink was carried with us from Windhoek. Having led similar trips in the Sonoran desert of Mexico, I can appreciate the huge effort the leaders made for us. All logistics were absolutely seamless. Even the only vehicle breakdown of the trip did not occur until after we had returned to the pavement at the end of the week!

The moonscape character of the Etendeka has a dreamlike quality. It amused me greatly to see thirty globe-trotting geologists, with a vast combined wilderness experience, repeatedly rendered incapable of speech by the awesome vistas. The group would periodically collapse on the ground en masse , immobilized by the beauty, while camera shutters clicked away.

The guidebook was superbly compiled by Andy Duncan, Simon Milner, and Dougal Jerram. Other leaders will be named in the course of this report. Andy Duncan was, unfortunately, unable to attend because of last-minute surgery. Simon Milner (Geological Survey of Namibia), the "head leader", was extremely efficient at providing delegates with logistical and geological information in the months preceding the trip, and helping delegates to arrange post-excursion trips to game parks. The delegates and leaders flew from Cape Town to Windhoek the day after the congress ended, where we visited the Survey to buy maps and made final preparations for our trip into the Etendeka and the Skeleton Coast National Park. "Etendeka" is the Himba word for the "flat-topped mountains" created by extensive quartz latite lava flows/ignimbrites. "Skeleton Coast" refers to the treacherous and remote coastline littered with shipwrecks.

The oldest rocks in northwest Namibia, the Damaran basement, include 900-700 Ma turbidites deposited in the paleo-Atlantic Ocean and deformed by the closure of the Kalahari craton to the south and the Congo craton to the north, at about 650 Ma. (The famous Ediacaran fauna in southern Namibia were then deposited in a foreland basin formed by this collision). We viewed the turbidites on Day 3 in the Ugab River-Rhino Canyon region, where they form a 1.7 km-thick section that is spectacularly folded with a western vergence. Our guide to these rocks was Roy Miller, retired Director of the Namibian Geological Survey. Roy was a valuable source of knowledge on the regional geology of Namibia, and also generously shared his great knowledge of Namibia's fascinating flora and fauna throughout the trip. Other stops in pre-Etendeka rocks included two localities in the Permian Dwyka Formation of the Karoo Sequence, to see Mesosaurus fragments (an alligator-like Gondwana fossil), and to view fossilized tree trunks deposited on a glacial outwash plain 100 miles from their source forest. The Karoo Sequence is interpreted to record 150 million years of extension prior to the onset of Etendeka volcanism.

Trip leader Julian Marsh explained to us that in the Etendeka, as in other flood basalt provinces, the term "basalt" is applied to mafic volcanic rocks with SiO_2 contents ranging from 48% to 58%. The basalts are tholeiitic, and fall into two main compositional groups, with one group ("HTZ") having much higher TiO2, Zr, P_2O_5 and other LIL element concentrations than the other ("LTZ"). The "HTZ" basalt lava flows are restricted the northern Etendeka, although basal conglomerates in the southern Etendeka contain altered basalt clasts of probable similar composition. These are probably the oldest basalts, and are interpreted to represent ocean island basalts derived from asthenospheric mantle. The "LTZ" basalt lava flows in the southern Etendeka were derived from melting of lithospheric mantle sources, or they derived their characteristics by interaction with lithospheric crust or mantle.

Silicic volcanic rocks of the Etendeka Group have been referred to as "quartz latites" (66-69% SiO_2). These are high in K_2O and FeO, and low in Al_2O_3 relative to "average rhyodacites", and were erupted at high temperatures (1000-1100°C). The quartz latites make excellent stratigraphic markers because individual units are widespread and compositionally homogeneous, yet composition varies enough from unit to unit to allow trans-Atlantic correlations between the Etendeka and the Parana province of Brazil. Quartz latite units less than 250m thick have been correlated for (predrift) distances of up to 500 km, with estimated volumes of up to 6,000 km^3. Individual eruptive units are up to 2600 km^3. Milner and coworkers have used these dimensions to support the hypothesis that the quartz latites are ignimbrites, although many of the features we saw on the trip are suggestive of lava flows, as discussed below. The cessation of quartz latite volcanism probably resulted from a reduction in crustal melting as Africa drifted off the hot spot.

Etendeka volcanic rocks are dated at 132 Ma. These in turn are intruded by dolerite dikes and sills that Julian Marsh suggested was derived by decompression melting of asthenospheric mantle during the initial stages of sea-floor spreading in the adjacent Atlantic, at about 123-127 Ma. This is also similar to the youngest ages on the Damara intrusive complexes. Due to time constraints, we could only examine one of these in detail, the Messum Complex. The Messum Complex postdates the sag structure that formed at the site of eruption of 9,000 km of Etendeka quartz latites.

The Messum Complex consists of 1000m of inward-dipping sheets in an 18 km diameter circle. Central rhyolites and basalts are intruded by heterogeneous granitoids and gabbro sills, including commingled magmas, and these in turn are intruded by gabbro and anorthosite dated at 132 +/- 1 Ma. Nepheline syenite intrusions formed the "last gasp" of the complex at 129 +/-1 Ma.

The week was so crammed full of fantastic outcrops and lively discussions that I cannot hope to summarize them fairly. I can only briefly describe what I believe to be some of the highlights.

- *Volcanology of the quartz latites.* Simon Milner achieved his goal on this trip, which was to demonstrate as fully as possible the physical characteristics of the quartz latite units, and allow the delegates to decide for themselves whether the quartz latites represent ignimbrites or lava flows. At the end of the week, there were still numerous people in both camps, plus some fence-sitters. It would require at least one long journal article to describe and interpret the features we saw, in the context of other published studies, and there are other people more qualified than I am to do this. One of the biggest questions is whether silicic lava flows can be so extensive, with such low aspect ratios. Possibilities we discussed included eruption of the quartz latites from silicic fire fountains, or from fire fountains with a Plinian core. Another possibility is that the quartz latites were erupted and largely transported as ignimbrites, behaving as lava flows only during the final stages of transport. Pyroclastic textures are only sporadically present to support the ignimbrite hypothesis, and these can be explained by the lava flow advocates as vesiculated parts of lava flows. Although some of the textures presented in photomicrographs do appear to be welded glass fragments, delegate Jocelyn McPhie pointed out that other textures interpreted as welded tephra could be "sheared perlite", or flow-banded rhyolite with platy "perls". The discontinuous nature of the basal breccias could be used to argue against a lava flow origin, or to argue for fluidal silicic lavas. The absence of breccias within quartz latite units could possibly be used to argue against progressive aggradation of ignimbrite, but not against mass emplacement of ignimbrite. The rarity of broken crystals in the quartz latites can be used to support the lava flow hypothesis, or to infer a "low explosivity" ignimbrite eruption. The nature of flow margins is unknown at Etendeka, but might possibly be more abrupt in lava flows than ignimbrites.

The delegates were shown a wide array of interesting features in the Etendeka quartz latites. We saw very irregular and pervasive, multi-centimeter vesicles toward the top of a flow unit, where volatiles were apparently "dammed up" beneath the pumiceous carapace. At several localities we saw evidence for hydraulic fracturing of quartz latite, attributed to continued exsolution and expansion of volatiles after the flow had largely solidified. We were also shown alteration zones, where breccias, pitchstone bodies, amygdales, eutaxitic structures and pumice occur throughout the flow, rather than being restricted to the bottom and top. The alteration zones are inferred to more rapid cooling at localities where the quartz latite interacted with water

- *Styles of eolian sedimentation, and interactions between volcanic and eolian processes.* A major erg occupied the Etendeka-Parana basin when flood volcanism began, and became progressively engulfed by the volcanism during its early stages, producing minor ergs and isolated dunes. Dougal Jerram led us through these. Rapid passive emplacement of lava flows during active sand migration resulted in outstanding preservation of entire dunes. We examined complete barchan dunes now exhumed by preferential weathering of the enclosing basalts. Larger transverse dunes ponded lavas to depths of 75m. It was the first time I had seen aeolian topset beds in the geologic record, or small parasitic dunes "frozen" in the act of climbing up the backs of larger dunes. Pahoehoe molds are preserved on the basal contacts of aeolian sand bodies, and lava flow imprint marks occur on the tops of sand bodies. Rubbly tops on some lava flows were filled in to depths of 3-4m by wind-blown sand, producing sand/lava breccias that may be mistaken for sand matrix-supported breccias in two-dimensional views. One particularly complex basalt-sand mixture had the group divided on the issue of whether or not water was involved, although most agreed that the basalt was emplaced was dynamically rather than passively.
- *Commingling of magmas in the Messum Complex.* Commingled magmas occur as sheets 60-80m thick and 14km long, referred to in the guidebook as "xenolith-choked granite". Delegate Jon Davidson was particularly instructive about the features of these commingled magmas. He pointed out that these and many commingled magmas elsewhere consist of a silicic and a more mafic rock with the same phases, only in different proportions. Many of the mafic inclusions show crenulated margins, suggesting that most were fluidal when they mingled with the granite. The mafic inclusions also have vesicles. White rims on the granite probably represent the lowest melting temperature granite getting 'sweated out" at contacts with the hotter mafic magma; then, as the mafic magma solidified and fractured, stringers of this granitic melt injected it. The resulting textures inspired names like "The Spotted Dog" and "The Organ Pipes", and triggered the consumption of unbelievable quantities of slide film.
- *Origin of breccias in the center of the Messum Complex.* Breccias in the core of the complex represent strata that foundered as the "last gasp" nepheline syenites were intruded. They thus provide the only sampling of surficial deposits in the Messum Complex, although their altered and hornfelsed nature makes them difficult to interpret. The breccias consist of clasts of extrusive or very shallow-level intrusive basalt, andesite and rhyolite. The breccias commonly have tightly-fit angular clasts and are nonsorted, with blocks up to 100's of meters across. Many of the larger blocks consist of rhyolite breccia cored by coherent rhyolite, representing fragments of lava domes. The consensus was that the breccias represent avalanche deposits shed from fault scarps within the Messum Complex.

One would have to wear blinders not to marvel at the exotic flora and fauna in the Namib. The Welwitschia Mirabilis is regarded as one of the three botanical wonders of the world. At first glance this wind-tattered, chewed, low-growing plant appears to be half dead, but in fact, it survives for a thousand years or more. It is a gymnosperm-angiosperm combination, with "pine cones" on the female plants and "seeds" on the male plants, pollinated by beetles. The "Bushman candle" is a plant with a wax that burns aromatically. The Euphorbia viros is the largest bush around, so it makes a convenient "facility", but watch out! If you touch it, you'll get blisters that last for weeks. The barren landscape supported a surprising number of small antelope Springbok as well as the larger Gemsbok (or Oryx). A large muscular zebra, the Hartmann's Mountain Zebra, ran the ridgelines individually or in small family groups. Stampeding ostriches are one of the most comical sights you'll ever see. Baboons are roadside pests, and warthogs are even uglier in person than they are in photos. Large chameleons remained perfectly frozen as we thronged around them with our cameras., and jackal appeared unconcerned with our presence.

Damaraland is world famous for its San (or "Bushman") rock art, which is some of the oldest in the world (30,000 years?). We camped one night by the Awahab petroglyphs, which are carved into aeolian sandstone of the Etjo Sandstone Formation. This locality has mainly representational art (animals) and lesser abstract designs, some of which may represent maps. In the Skeleton Coast National Park we visited Bushman stone structures of unknown age, consisting of quartz latite slabs placed on end in circular patterns, with pot fragments littering the floors.

I applaud the leaders, and also the delegates, for pulling together for making this safari so pleasant. Not everyone on the planet can be cheerful about showering in one quart of water each day! After a week of dire warnings about the impending grimness of our last campsite, "Pilchard Gorge", it was so funny to watch Marta Mantovani get out of the car, shrug, and say "It's just like all the rest". Granted, we were lucky with the weather on the Skeleton Coast, which can be much foggier and windier than we had.

I highly recommend the guidebook, which is beautifully written and well-illustrated. My only regret is, I don't have any immediate plans to go back!

PARTICULATE GRAVITY CURRENTS CONFERENCE

Leeds, September 7-9, 1998

Contributor: Ulrike Martin, Otago University, NZ; uli_martin@hotmail.com)

The first Particulate Gravity Currents Conference was sponsored by SEPM and the Geological Society of London and held at the University of Leeds in September 1998. Convenors were Ben Kneller, Bill McCallrey, Jeff Peakall (Leeds, UK) and Tim Druitt (Clermont-Ferrand, France). The organizing committee did a great job, especially in organizing the oral and poster presentations, so that there was enough time for studying the posters and to have some great discussions. Money was available for student grants to help and encourage students to attend the meeting, which really helped a lot.

***19th REGIONAL EUROPEAN MEETING OF SEDIMENTOLOGY**
August 24-26, Denmark (Copenhagen)
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The three-day meeting focused on processes of sediment transport and deposition in geologically or environmentally important gravity currents, and on their resulting products.

Keynote speakers were:

- Peter Baines (CSIRO, Aspendale); Downslope flows into stratified environments
- Charles Campell (University of Southern California); granular flows: a somewhat personal perspective
- Herbert Huppert (Cambridge University); Quantitative evaluations of particle flows
- Gary Parker (University of Minnesota); Submarine debris flows and turbidites: flow mechanism and deposits
- Tamotsu Takahashi (Uni. Kyoto); Mechanism and simulations of debris flows, pyroclastic flows & snow avalanches

Demonstrations were held in the Sedimentological Fluid Dynamics Laboratory, and included: (1) quasi-steady particle/solute driven flows, instrumented using LDA; (2) small scale, radially-expanding, surge-type particle-driven flows; (3) ultrasonic velocity profiling (UVP) applied to steady, particle-laden shear flows; (4) large-scale, radially expanding quasi-steady particle-solute-driven flows, and; (5) laboratory demonstration of autosuspension. The lab is fully equipped and it was quite interesting to follow the demonstrations. For me one of the most impressive video demonstrations was presented by Elwaine, Nishimura & Nohguchi on Ping-Pong ball avalanches. The experiment was carried out with 350,000 ping-ping balls on a ski jump.

Two parallel field trips followed the meeting: (1) ancient turbidites in the Annot area of the south-western French Alps (Leader: Ben Kneller, Bill McCaffrey); (2) pyroclastic deposits of the Thera-Santorini eruption in the Aegean, Greece (Leader: T.H. Druitt).

For people who are interested in some of these topics, a Special Publication of the International Association of Sedimentologists (IAS) will provide a good representation of the topics covered at the meeting. The thematic conference book will provide reviews by keynote speakers, together with a selection of papers from each major theme of the conference. It is intended to go to press (Blackwell Scientific, publisher) sometime before the end of this year.

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Introductions and Greetings in English. With dictionary look up. Double click on any word for its definition. This section is in advanced English and is only intended to be a guide, not to be taken too seriously! With dictionary look up. Greetings and Introductions. First impressions are a really important aspect of British culture. Introducing yourself and others in the correct way is fraught with various do's and dont's of etiquette. Introductions. In social situations, a man is traditionally introduced to a woman. Basic greeting and introductions and responses. This English lesson you will learn how to ask someone for there full name and what to ask them if you don't understand what they are saying. Greeting and introducing yourself. Hello, my name is John, what is your name? Hi John my name is Jane pleased to meet you. 1 Greetings and Personal information introductions Introductions and greetings London attractions. Introductions and greetings General questions: short answers. 4. 2 Daily routines School routines in different countries. Life at Hogwarts Daily life Journey in time. Talking about time of the day General and special questions Adverbs of time always, sometimes, often, usually, never Expressing agreement (too, either). 14. 3 Family members. Origin and nationality The Royal family Nationality puzzle.