

corresponding H_{irr} of our $x = 0.6$ crystal was 0.4 T, twice as large as their value. The lack of data at higher temperatures in their report (3) prevents us from making a comparison above 50 K. These differences in J_c and H_{irr} at high temperatures must reflect an essential difference in the inherent pinning mechanism between their and our crystals. Wang *et al.* attributed the increase of J_c to the disordering of the modulation, as deduced from the examination of one Pb composition. In contrast, we studied the Pb-doping effects in a systematic way using crystals with different Pb contents from both magnetic and structural points of view and deduced the relation between the enhancement of J_c and the appearance of the specific microstructures. Large enhancements of J_c and H_{irr} were revealed for crystals with Pb content of $x \geq 0.6$ in which a two-phase microstructure appeared. Relatively small but significant increases in J_c and H_{irr} were found for the $x = 0.4$ crystal, but not for the $x = 0.6$ crystal. The minor improvement in the $x = 0.4$ crystal must have another origin, such as reduction in anisotropy, generation of point defects, or a disorder in the modulation as pointed out by Wang *et al.* (3).

Our work clearly demonstrated that the flux pinning is dramatically enhanced even at 50 to 60 K, at which point the specific, Pb-

content-alternating microstructure appears.

Lieber and Yang referred to the transmission electron microscopy (TEM) study by Chen *et al.* (4), where a striped domain structure was described. But these stripes were parallel to the [110] or [210] direction. This was not the case in our TEM observations, where the domain interface was always perpendicular to the [010] direction. Also, we noted the absence of any modulations in every second stripe. No comments were made by Chen *et al.* on the relation between the domain structure and the nature of modulation. It is difficult to find any definite relation between their TEM results and ours. Chen *et al.* (4) do not discuss J_c .

Finally, concerning the STM results by Lieber's group, we are not convinced that STM experiments can really detect inhomogeneity or disorder inside crystals. It is only a cleaved surface that is examined by this method. There are no guarantees that a BiO layer keeps its original properties after the counter BiO layer is removed.

Zenji Hiroi
Mikio Takano

Institute for Chemical Research,
Kyoto University, Uji, Kyoto-Fu 611, Japan

References

1. Y. L. Wang, X. L. Wu, C.-C. Chen, C. M. Lieber, *Proc. Natl. Acad. Sci. U.S.A.* **87**, 7058 (1990).
2. I. Chong *et al.*, *Science* **276**, 770 (1997).
3. X. L. Wu, Z. Zhang, Y. L. Wang, C. M. Lieber, *ibid.* **248**, 1211 (1990).
4. C. H. Chen, D. J. Werder, G. P. Espinosa, A. S. Cooper, *Phys. Rev. B* **39**, 4686 (1989).

A Hill of Beans

Alexander L. Densmore *et al.* (Reports, 17 Jan., p. 369) address an important geomorphologic question: What is the relative importance of large, infrequent, slope-clearing events (SCEs) in determining hillslope longitudinal profiles? To model the frequency and magnitude distribution of SCEs, they filled a narrow [2.5-centimeter (cm)] flume with red beans, slowly lowered an outlet on one end to simulate an incising river, and recorded the resulting mass flux from their simulated hillslope with each 0.5-cm drop in base level. While occurring only 10% of the time, SCEs in their flume accounted for 70% of the total mass removed from the landscape. Between individual SCEs, smaller events developed steep "inner gorges" that were eventually cleared by the next SCE, which suggests that similar features in natural landscapes reflect SCE frequency, not changes in river incision rate as typically assumed.

We were intrigued by the results from this simulation of hillslope failure and recreated

What would you say to this statement: "minutes are all it takes to conquer the intricacies of chromatography"? Something like: "Prove it"? Good. The next time you need help with purification, contact Pharmacia Biotech.

Complete purification and separation support

We offer the broadest, most comprehensive range of support to help you get ahead in your research. And to help you stay ahead. Our technical support scientists are always available for you. In fact, every minute of every day people are talking to us about purification and separation. Yearly, we organize detailed purification and separation seminar programs.

You can get a vast amount of technical advice by contacting us. For instance, we can fax a data file to you in minutes—or deliver any of our well-known application handbooks to you. Restated, we're ready to help you anytime and anyway you need it.

Our chromatography products will provide you with speed, consistency, and reliability. Consider, for example, our latest purification systems: ÄKTA™ design (pronounced eckta design). Each system provides you with the digital integration of our more than 50 years of chromatographic expertise with built-in pre-programmed protocols for all major purification methods and techniques. Which means, with Pharmacia Biotech support and products, you can literally conquer chromatography in minutes.

Find out more about Pharmacia Biotech. Give us a call: 1 (800) 526-3593 in the USA; +81 3492 6949 in Japan; +46 18 16 50 11 in Europe and the rest of the world.

Or visit us on the Internet: <http://www.biotech.pharmacia.se>.



Precipitate Nucleic Acids.

IN COLOR!

Pellet Paint™ Co-Precipitant

A highly visible, inert carrier for routine DNA or RNA precipitation.*

EFFICIENT PRECIPITATION OF DNA AND RNA

- Quantitative recovery of nucleic acids
- Five minute procedure
- No low temperature incubations
- Suitable for precipitation of dilute samples (<2ng/ml)

NO MORE LOST SAMPLES!

- Vivid pink pellets are easily located
- Consistent precipitation ends uncertainty
- Precipitation and resuspension steps are easily confirmed

COMPATIBLE WITH MANY APPLICATIONS

- Pellet Paint contains no DNA, RNA or nucleases
- No inhibition of downstream reactions
- Qualified for:
 - manual and Cy5** sequencing
 - PCR† amplification
 - cDNA synthesis
 - random priming
 - transformation
 - ligation
 - restriction digestion
 - kinase reactions
 - *in vitro* transcription
 - *in vitro* translation
 - gel electrophoresis

*Patent pending

**Cy5 is a trademark of Biological Detection Systems, Inc.

†The PCR process is covered by patents owned by Hoffmann-La Roche.



Novagen

Novagen, Inc.
597 Science Dr.
Madison, WI 53711
e-mail: novatech@novagen.com
URL: <http://www.novagen.com>
800-526-7319
Fax: 608-238-1388

Circle No. 47 on Readers' Service Card

$(x,y,z) \cdot H^{-1}(x,y,z)$

Digital Imaging Systems & Solutions

Midsagittal view of internal cranial anatomy of 170-day-old pigtail macaque fetus. Rendered with VoxBlast to study bone growth and bone trauma. Courtesy Michael Zumpano, Biology Dept., Chatham College, PA.

VoxBlast™ –

3D Measurement
and 3D Visualization
for Windows 95/NT,
Power Macintosh and UNIX

MicroTome™ HazeBuster™ –

Software for Microscopy,
out-of-focus haze removal

VolumeScan™ –

Software Control for
Z Stage, Filters and Shutters

VayTek, Inc.

EMAIL vaytek@vaytek.com
WEB <http://www.vaytek.com>
TEL (515)472-2227
FAX (515)472-8131
Fairfield, IA 52556

**VayTek Retrofits
to Existing
Systems**

Circle No. 12 on Readers' Service Card

the bean model in a graduate seminar. Initial results suggested that flume width controlled the frequency and mechanics of failure, so we built a larger model with adjustable dimensions (1) to further measure the effects of different boundary conditions. As flume width increased, SCEs occurred more frequently (Table 1), "inner gorges" vanished, slopes smoothed, and gradient decreased. Unexpectedly, frequency-magnitude changes balanced such that average SCE mass remained roughly constant up to a 10-cm width. Our additional experiments demonstrated that flume width (relative to grain diameter) is a first-order control on failure form, frequency, and magnitude (2). Our results confirm previous work (3) which showed that the effects of increasing boundary width diminish above six-grain diameters (approximately 10 cm). Boundary conditions, granular interaction, and packing control failure mechanics of granular materials (4); particle wedging, bridging, and brick-like stacking one-dimensional to two-all constrained failure in our flume at narrow widths. Boundary effects aside, as grain slopes widened from 1-dimensional to 2-dimensional, lateral noise propagation reduced the self-organized critical slope by amplifying chain reactions (5). The physical behavior on which Densmore *et al.* based the geomorphic relevance of their experiments vanished upon widening of the flume in our experiments. Because landslides are generally wide (6), the extrapolation made by Densmore *et al.* from the behavior of a hill of beans to bedrock hillslope evolution appears to be unwarranted.

Rolf Aalto

David R. Montgomery

Bernard Hallet

Timothy B. Abbe

John M. Buffington

Kurt M. Cuffey

Kevin M. Schmidt

Department of Geological Sciences,
University of Washington,
Seattle, WA 98195-1310, USA

References and Notes

1. Our steel-framed plexiglass flume measures 38 (length) × 85 cm (high) and adjusts to be up to 25 cm wide. For each width, results were calculated from approximately 200 boundary drops. Red beans averaged 1.74 × 0.80 × 0.51 cm, and our analysis followed that in the report by Densmore *et al.*
2. For narrow widths, flume length and depth also appeared to have had an effect, albeit minor.
3. A. van Burkalow, *Geol. Soc. Am. Bull.* **56**, 669 (1945). At larger widths, our red beans exhibited behavior similar to the smooth slopes reported for white beans in the report by Densmore *et al.*; thus, differences in bean size, not anisotropy, may account for the two modes of behavior reported by Densmore *et al.* for the 2.5-cm flume (1).
4. H. M. Jaeger, S. R. Nagel, R. P. Behringer, *Phys. Today* **50**, 32 (April 1996); Y. Onda and Y. Matsukura, *Earth Surf. Process. Landforms* **22**, 401 (1997).
5. P. Bak *et al.*, *Phys. Rev. A* **38**, 364 (1988).
6. N. Hovius, C. P. Stark, and P. A. Allen [*Geology* **25**, 231 (1997)] found the mean plan form of Southern

Table 1. Experimental variables and results of hillslope failure modeled with red beans.

Width (cm)	Flume width/bean length	SCEs (%)	Slope (deg)	SCE mass (g) (average)	SCE mass (%)
2.5	1.4	11	37.1 ± 1.7	260 ± 96	66
5	2.9	30	33.7 ± 1.1	213 ± 93	76
10	5.8	49	31.8 ± 0.8	264 ± 135	81
15	8.6	50	32.2 ± 0.5	348 ± 131	78

New Zealand Alps landslides to be approximately elliptical, with an aspect ratio of about 2.0 across all length scales.

Response: Aalto *et al.* properly draw attention to the potential role played by laterally confining stresses in the behavior of dry red beans in response to a falling base level. There are several reasons, however, why their rejection of our interpretations may be premature. The statistics of slides in anisotropic dry beans, in contrast to those in almost-spherical white beans, are similar to the albeit few observational data about landslides (1). As in our report, we attribute this behavior to the supporting shear stresses induced by the shape anisotropy of the red beans and draw attention again to experiments with rice (2), which showed behavior fundamentally different from that of almost-spherical sand grains. While such statistical agreement is not by itself conclusive, it suggests that real hillslopes are more analogous to those experiments with beans that include some form of supporting shear stresses imparting an integrity or coherence.

The origin of supporting shear stresses and confining normal stresses may be quite diverse and, as suggested by Aalto *et al.*, may arise from the confining walls of our relatively narrow experimental apparatus. By increasing the width of their apparatus, Aalto *et al.* decreased the effects of the walls, creating wide, planar model hillslopes. Real hillslopes are rarely planar, however, and supporting stresses may arise within a ridge and valley topography (3), in which the falling base level (for example, an incising river) meanders. Thus, we might expect ridge lines (or spurs) to be sites of relatively less confining normal stresses and hollows (or tributary valleys) to experience greater confining stresses. The degree and variability of channel sinuosity versus the material strength and cohesiveness will presumably influence the behavior of landslides over both space and time. It is also possible that there exist various length scales, even in planar hillslopes, at which failure of the hillslope occurs en masse or in discrete units, the latter yielding inner gorges, the former not. For example, mass wasting along the lee sides of sand dunes is organized into discrete grain flows, despite the planar nature of such slopes (4). We expect that bean experiments on a yet wider apparatus would show evi-

dence of such organization. Supporting stresses may also occur in heterogeneous geology or in response to an externally imposed stress field that is still further complicated by fault activity in the upper few kilometers of the crust. Neither our simple model nor that of Aalto *et al.* is capable of addressing these more complex and interesting issues.

Finally, we reiterate that inner gorges are commonly observed features in many mountainous landscapes; they occur at various length scales and at various distances upstream from local base level. It is highly unlikely that the origins of all such inner gorges can be tied to global changes in base level, whether tectonically or climatically controlled. A simpler explanation is that the natural development of hillslopes involves the generation of inner gorges and intermediate scarps, as demonstrated in our experiments.

Alexander L. Densmore

Department of Geology,
Trinity College, Dublin 2, Ireland

Robert S. Anderson

Department of Earth Sciences,
University of California,
Santa Cruz, CA 95064, USA

Michael A. Ellis

Center for Earthquake Research and
Information,
University of Memphis,
Memphis, TN 38152, USA

References

1. T. A. Blodgett *et al.*, *Eos* **77**, S261 (1996); N. Hovius, C. P. Stark, P. A. Allen, *Geology* **25**, 231 (1997).
2. V. Frette *et al.*, *Nature* **379**, 49 (1996).
3. D. J. Miller and T. Dunne, *J. Geophys. Res.* **101**, 25523 (1996).
4. R. R. McDonald and R. S. Anderson, *J. Sediment Res.* **66**, 642 (1996).

Letters to the Editor

Letters may be submitted by e-mail (at science_letters@aaas.org), fax (202-789-4669), or regular mail (*Science*, 1200 New York Avenue, NW, Washington, DC 20005, USA). Letters are not routinely acknowledged. Full addresses, signatures, and daytime phone numbers should be included. Letters should be brief (300 words or less) and may be edited for reasons of clarity or space. They may appear in print and/or on the World Wide Web. Letter writers are not consulted before publication.



TIME MACHINE

**THE NEW
MINI-PREP 24**

**FOR AUTOMATED
PLASMID MINI-PREPS**

- **Fast**—up to 24 preps per hr, saving you valuable time.
- **High Purity**—sufficient for automated fluorescent and manual sequencing.
- **Easy Operation**—begin prep with direct loading of bacterial culture. No centrifugation step saves you time.
- **Consistent Results**—up to 6 µg of plasmid per ml. Quality DNA ... time and time again.

Call now to learn how the New Improved Mini-Prep 24 can give you quality DNA and save time by automating your plasmid DNA preps!

1-800-466-7949

MacCONNELL
RESEARCH

11339 Sorrento Valley Road
San Diego, CA 92121
(619) 452-2603 • Fax (619) 452-6753
www.macconnell.com

Circle No. 23 on Readers' Service Card