melts when 'squeezed' by increasing the external field.

Although more detailed theories are available[2], a qualitative understanding results if thermal fluctuations in the crystal are modelled by a single vortex filament in the cage formed by the repulsive interactions with its neighbours[9]. Both the flexibility of the line and the range of interactions are important. The flexibility determines how far along the average field direction the line wanders before it is deflected back by the bars of its cage. The denser the vortex array, the more these collisions increase the entropic cost of the crystalline phase. When the vortex interactions are relatively long range (as is usually the case), squeezing triggers a melting transition when the density is high enough that the extra entropy of vortex braiding in an entangled flux liquid phase outweighs the potential energy cost. A density reduction on freezing might also be expected when flexible nematic polymers with low salt concentration crystallize into the hexagonal columnar phase. DNA molecules, for example, have interactions quite similar to vortices in superconductors[10]. Similar physics causes quantum solids with long-range interactions to melt when squeezed, with zero-point energy replacing entropy in the above arguments.

Related arguments[2] show that the Abrikosov vortex crystal must also melt at very low densities and fields, along the reentrant dashed curve shown in the figure. The physics of low-field melting, the field dependence of vortex configurations at very low temperatures and the behaviour above the high-field critical point are inviting subjects for future investigation.

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1. Zeldov, E. *et al. Nature* **375**, 373–376 (1995).
2. Blatter, G. *et al. Rev. mod. Phys.* **66**, 1125 (1994).
3. Brezin, E., Nelson, D. R. & Thiaville, A. *Phys. Rev.* **B31**, 7124–7131 (1985).
4. Safar, H. *et al. Phys. Rev. Lett.* **69**, 824 (1992).
5. Charalambous, M. *et al. Phys. Rev.* **B45**, 45 (1992).
6. Jiang, W. *Phys. Rev. Lett.* **74**, 1438–1441 (1994).
7. Safar, H. *et al. Phys. Rev. Lett.* **71**, 436–439 (1993).
8. Fendrich, J. A. *et al. Phys. Rev. Lett.* **74**, 1210 (1995).
9. Nelson, D. R. in *The Vortex State* (eds Bontemps, N. *et al.*) 41–61 (Kluwer, Dordrecht, 1994).
10. Podgornik, R. & Parsegian, V. A. *Macromolecules* **23**, 2266 (1990).

ARCHAEOLOGY

Drought and decline

Jeremy A. Sabloff

AROUND AD 800, something happened to the Classic Maya civilization. The relatively sudden decline seen at many sites, particularly in the southern lowlands (which lie in modern-day Guatemala, Mexico, Belize and Honduras), has garnered considerable scholarly and lay interest over the years[1]. On page 391 of this issue, Hodell and co-workers[2] supply fresh evidence that may point the finger at climate changes in the region as one key factor in this decline.

In the past two decades, as archaeological field research in the Maya area has boomed and the deciphering of Maya hieroglyphic texts has generated new historical information, archaeological understanding of the 'collapse' of Classic Maya civilization has grown[3–5]. Interrelated factors including population growth, environmental degradation and intercity conflict have been implicated in the process of decline. In addition, the concurrent florescence of cities in the northern lowlands such as Uxmal, Kabah, Sayil and Chichén Itzá and the lack of decline at certain sites in the southern lowlands with advantageous riverside locations can now be better appreciated, as these centres are situated either in zones with previously low populations or in locations that provided economic buffers against severe environmental strains. It also has become apparent that the exact triggers, many of which have yet to be identified, for the collapse of individual cities may have varied within the overall matrix of demographic and environmental pressures.

The new research by Hodell, Curtis and Brenner[2], adds another important component to the model that archaeologists are currently building to help explain the upheavals of the late eighth century and early ninth century AD in the Maya lowlands. As some of the factors were present well before AD 800 and the ancient Maya suffered previous setbacks in their development[6], one unanswered question has been why these factors had such a cataclysmic effect around AD 800. What Hodell *et al.* find, by examining sediment cores from Lake Chichancanab in the northern lowlands of the Yucatán peninsula (see map), is that a period of increased climatic dryness set in around AD 800.

To a civilization facing a number of stresses both internal and external, the scarcity of water could have greatly increased the vulnerability of numerous Classic Maya cities, especially in the southern lowlands where the strains were greatest. In particular, with the landscapes around many Maya centres already under heavy stress[7,8], the arrival of a drier regime would have exacerbated the perilous situation, ultimately causing the demise of elite power, the abandonment of many urban centres, and important demographic and economic shifts from the southern to the northern lowlands. Continued dryness for two centuries, as the results of Hodell *et al.* suggest, might also have inhibited cultural and demographic recovery in the previously degraded parts of the southern lowlands.

The Yucatán peninsula showing the coring site (Lake Chichancanab) of Hodell *et al.*[2] and Maya sites mentioned in the text.

The research by Hodell and colleagues contributes to scholarly attempts to understand why and how the Classic Maya successfully adapted to their tropical environment for so many centuries, overcoming numerous problems and reaching population levels that far exceed modern ones in the same area, and why they ultimately failed. Their research also raises an anthropological question that is relevant not only to the ancient Maya but to the contemporary world as well, and is certainly deserving of continued attention — namely, how severe do internal stresses in a civilization have to become before relatively minor climate shifts can trigger widespread cultural collapse? □

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1. Culbert, T. P. *The Classic Maya Collapse* (Univ. New Mexico Press, Albuquerque, 1973).
2. Hodell, D. A., Curtis, J. H. & Brenner, M. *Nature* **375**, 391–394 (1995).
3. Sabloff, J. A. *The New Archaeology and the Ancient Maya* (Freeman, New York, 1990).
4. Sabloff, J. A. & Henderson, J. S. (eds) *Lowland Maya Civilization in the Eighth Century AD* (Dumbarton Oaks, Washington DC, 1993).
5. Sharer, R. J. *The Ancient Maya*, 5th Edn (Stanford Univ. Press, 1994).
6. Marcus, J. in *Lowland Maya Civilization in the Eighth Century AD* (eds Sabloff, J. A. & Henderson, J. S.) 111–184 (Dumbarton Oaks, Washington DC, 1993).
7. Rue, D. J. *Nature* **326**, 285–286 (1987).
8. Rice, D. S. in *Lowland Maya Civilization in the Eighth Century AD* (eds Sabloff, J. A. & Henderson, J. S.) 11–63 (Dumbarton Oaks, Washington DC, 1993).