along a 200-km length of the Juneau gold belt of Alaska. The veins were formed at depths of more than 5 km (but probably less than 10 km) and at temperatures of around 300 °C, and as such are typical of the so-called mesothermal gold deposits which crosscut many of the world's metamorphic belts. Similar vein systems provoked gold rushes in the United States, formed the basis of the wealth of European cities such as Salzburg, and have provided the British royal family with their wedding rings. The fluids which form such deposits appear to be remarkably uniform. Typically they are low-salinity H_2O–CO_2 fluids containing CH_4, N_2 and H_2S.

Although it has long been realized that deposits of this type probably form over relatively short periods of time, Goldfarb *et al.* have obtained ages precise to significantly better than 1 million years, and demonstrate for the first time the true brevity of the vein forming event. Ages along a 200-km vein system all lie between 55.0 and 56.1 million years. It is clear from both the geological context and the argon release profiles that these are true ages of formation and not the result of some subsequent resetting of the argon clock. At about this time in the early Eocene there was a significant change in the angle of convergence of the Kula Plate (part of the Pacific Ocean floor, now completely subducted) relative to the North American Plate, and Goldfarb *et al.* suggest that the veining event was triggered by the shift away from compressional tectonics. What we see here, however, is not a shift from one steady state to another, but a singular, brief event, triggered by the change in plate motion.

Quartz is not a particularly soluble substance, even at 300 °C; indeed the presence of CO_2 and other non-polar fluid species serves to suppress its solubility. The quartz veins probably formed from fluids that carried at most only a few hundred parts per million of silica in solution. The presence of elevated gold concentrations and the alteration of wall rocks rule out an origin for the vein quartz by local segregation from nearby rocks. These veins clearly represent major pathways of focused fluid flow through the crust. As such, the rapid formation of the gold-quartz veins acquires further significance because they may also throw new light on the contentious issue of whether fluid is present deep in the Earth's crust.

Some geophysicists[2] have argued that significant quantities of water are present deep in stable continental crust at the present time, and so account for the electrical conductivity of the deep crust. It has also been suggested that such saturated zones may give rise to seismic reflections. On the other hand, metamorphic petrologists point out that any water remaining in metamorphic rocks once they have begun to cool will be rapidly absorbed by retrograde reactions producing hydrous minerals[3]. The extensive preservation of anhydrous, high-temperature metamorphic minerals suggests that the rocks were dry throughout their post-metamorphic history. Goldfarb, with additional co-workers, has recently published isotope data on

A typical late metamorphic quartz vein, from Val d'Ayas, Italy, one of a suite that has been mined for gold. CO_2 in the fluids responsible for the vein altered the wall rocks to give brown-weathering carbonate minerals.

minerals from the Juneau veins[4], which they believe provide clear evidence that the vein-forming fluids were indeed metamorphic waters from deep in the crust that had survived at depth by some kind of ponding process. In this issue, he and his colleagues propose that the veins formed when the changing regional stress pattern allowed them to break through an impermeable cap layer. Thus the veins form in a brief event as deep over-pressured fluid reservoirs are drained along new fractures.

Clearly this is an attractive and cogent hypothesis, but it is unlikely to sweep aside all doubts about the persistence of deep fluids. The principal alternative is that the vein fluids moved down from the surface. Unfortunately, testing between such radically different alternatives will remain difficult because at elevated temperatures fluids are continually exchanging material their hosts so that any geochemical memory of the nature of the fluid at source becomes blurred or lost. □

Bruce W. D. Yardley is in the Department of Earth Sciences, University of Leeds, Leeds LS2 9JT, UK.

1. Goldfarb, R. J., Snee, L. W., Miller, L. D. & Newberry, R. J. *Nature* **354,** 296–298 (1991).
2. Gough, D. I. *Nature* **323,** 143–144 (1986).
3. Yardley, B. W. D. *Geology* **9,** 405–408 (1981).
4. Goldfarb, R. J., Newberry, R. J., Pickthorn, W. J. & Gent, C. A. *Econ. Geol.* **86,** 66–80 (1991).

DAEDALUS

Broken dreams

TELEVISION, says Daedalus, is the most pernicious of inventions. It may appear to convey information, but in fact it conveys dreams. The unspoken, unchallenged, unrealizable ideals of whole societies are now defined by television. Worse, because television is extremely expensive to set up and run, the ideals it broadcasts are those of the rich. The effects on developed societies are bad enough. But global satellite television is now beginning to taunt the vast population of the underdeveloped world with dreams of riches that are unfeasible even to the industrial nations. The resulting mass envy and frustration must inevitably lead to some kind of global social disaster.

So Daedalus is looking for some way of sabotaging satellite television, preferably without drawing attention to the fact. Accordingly, he has developed a renewed interest in the Earth's threatened ozone layer. He advocates the replacement of halocarbon fluids in refrigerators and air-conditioners by the traditional refrigerant, ammonia. He is also reviving an old scheme of his to stabilize the ozone layer with direct injections of ammonia. In the stratosphere, the ammonia will be photo-oxidized to nitrogen oxides; these will combine with the crucial free radicals responsible for the chain reaction that destroys the ozone. As militant ecologists denounce the over-fertilization of the land by ammonia fertilizers, the chemical industry should be happy to find an environmentally benevolent outlet for millions of tons of surplus ammonia. It should eagerly support Daedalus's plan to inject the gas into the stratosphere by means of huge vortex-ring generators to squirt it upwards. Because ammonia is lighter than air it should rise anyway; deliberate emissions and releases from leaky air-conditioners and discarded refrigerators will all accumulate in the stratosphere.

Daedalus's hidden agenda is very simple. Ammonia has a wide range of strong absorption bands across the 10–18 GHz region which contains the satellite-TV uplink and broadcast frequencies. As his virtuous attempts to save the ozone layer develop, global television will be rapidly degraded. A satellite channel has no power to spare for attenuation losses, even with sensitive big-dish receivers. Relatively little atmospheric absorption should black it out completely. With luck it should not be at all obvious what is happening. To get any signal through at all, global broadcasters will be forced to narrow their bandwidth right down, until there is only enough space for simple radio. And radio really does transmit information, not dreams. David Jones