



### **Pipeline over Alaska's permafrost**

The Trans-Alaska oil pipeline was one of the great construction feats of the 1970s. It can carry 300,000 tonnes of 'black gold' per day from the oilfields around Prudhoe Bay to the tanker port at Valdez, though it is currently operating at less than a third of its capacity. Most of the route is across permafrost, so the pipeline could not be simply buried. Its crude oil has to be kept at 5–20°C, because it becomes progressively more viscous as it cools down. The problem then is that its own warmth would thaw the permafrost around a buried pipeline, and would turn stable frozen ground into unstable soggy bog. In such terrains, conservation of the permafrost is essential to ensure any sort of ground and structure stability. So for about half of its length the pipeline rests on 40,000 trestles, each of which has two pile supports. The piles themselves must be kept frozen into the permafrost; any summer warmth conducted downwards could cause catastrophic subsidence. Most of the piles therefore have internal refrigerators. Inside the tops of these thermopiles, ammonia is cooled to a liquid in the heat fins that are exposed to the Alaskan winter. The liquid falls to the toe of the piles, where it vaporises, and its latent heat is taken from the ground, thereby cooling it. Ammonia gas circulates back up inside the piles, and the cycle repeats. No external power is required, though circulation may reduce during the short summers when air temperatures are too high. Thermopiles distinguish this section of the pipeline, in the pass through the Alaska Range, where it lies across permafrost that is only marginally stable and is covered by taiga vegetation with its scattered trees. Normal piles, without cooling, are adequate on thaw-stable gravels and on rock, and also further north on the Arctic Plain, where temperatures are so low that the permafrost is stable. The elevated pipeline is a splendid example of geo-engineering, where ground conditions dictated the entire nature of the construction project. © *Photograph and text by Tony Waltham Geophotos*