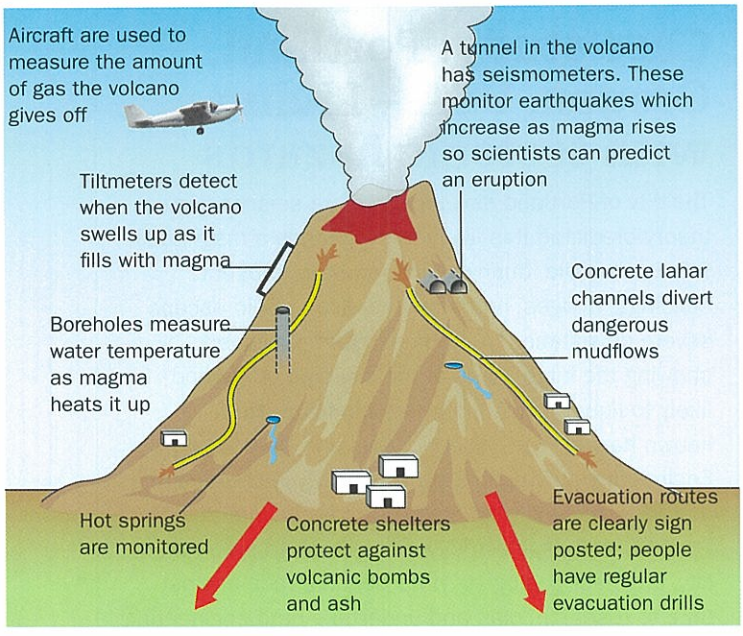

Fig. 9.29 Some ways in which volcanic hazards are reduced

→ economic reasons, as people are reluctant to leave their jobs. Sulphur is mined from active volcanoes and basic lavas weather to fertile soils suitable for intensive agriculture, as on the densely populated island of Java. Geothermal energy in volcanic areas leads to industrial developments and cheap heating for homes and for crops grown in hothouses, as in Iceland. The dramatic volcanic landscape attracts tourism, which encourages population growth. For such reasons, people believe that the benefits from living in a hazardous area will be greater than the costs of doing so.

Hazards resulting from mass movements

Mass movements and resultant hazards: nature and causes

The physical and human causes of types of mass movements are described in Chapter 3. A mass movement which affects people and their property is a hazard, especially when it is unexpected and large-scale but even a single rock fall can be hazardous. Human mismanagement is a prime cause of slope instability.

Types of hazardous mass movements

Movement is mainly through the air in rock and debris **falls**. **Slides** and **flows** move on the surface both downward and outward. The more rapid ones are the more hazardous. A slide is distinguished from a flow by being a solid mass moving along a single failure plane or fracture zone. Further classification is based on the nature of the material moved. Dry material can produce hazardous movements ranging from rock and debris falls and slides to **slumps**. Hazardous flows occur when earth (fine material) or rock (coarser material) is mixed with water to form earthflows, mudflows and lahars.

Both landslides and landslips (slumps) occur in solid rocks and in weathered material. In a landslide, the plane along which movement takes place is inclined and the material moves in a mass, breaking up where it comes to rest. In a slip or slump the movement is rotational along a curved **slip plane** and results in an arcuate slip face and a relatively unbroken **toe** which rises towards the end of the slipped mass. Landslips occur in areas with rock types of different permeability.

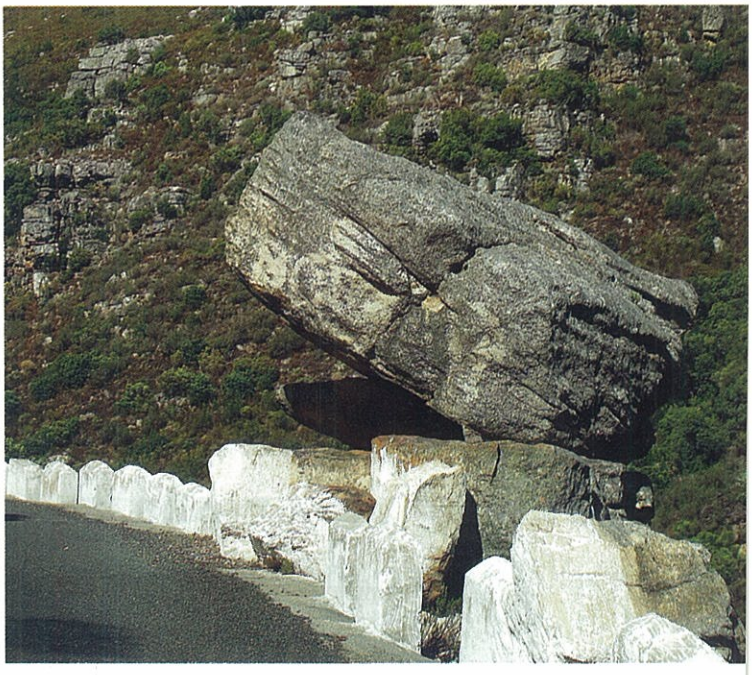

Fig. 9.30 Rock falls from cliffs are localised hazards along mountain roads

Fig. 9.31 A small debris slide in the Peruvian Andes