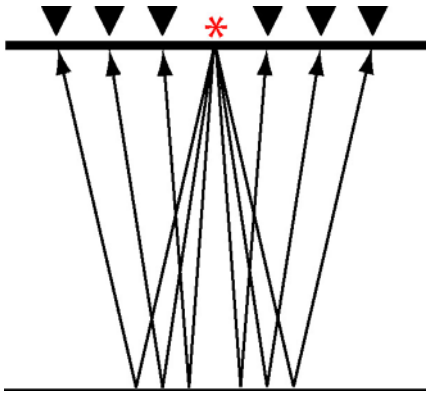
C2.3 Strategies for collecting seismic data

C2.3.1 Shot gather

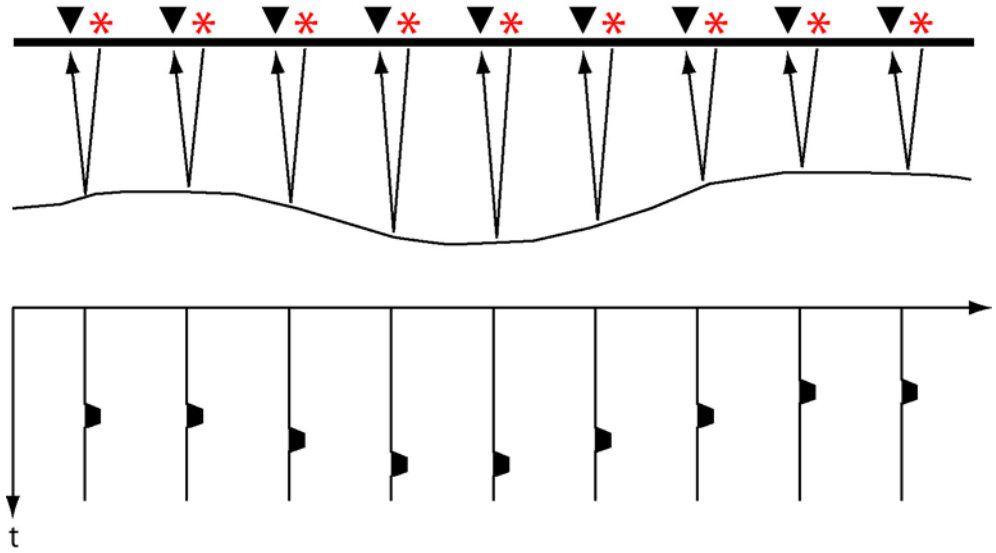
- The shot gather allows us to determine the **variation of velocity with depth** through the measurement of the normal moveout.

- The seismic survey measures time. Processing techniques are used to convert time to depth.

- In a shot gather, each ray will reflect at a **different location**. If the structure varies significantly in the horizontal direction, then this will introduce errors.



C2.3.2 Single channel seismic profiling



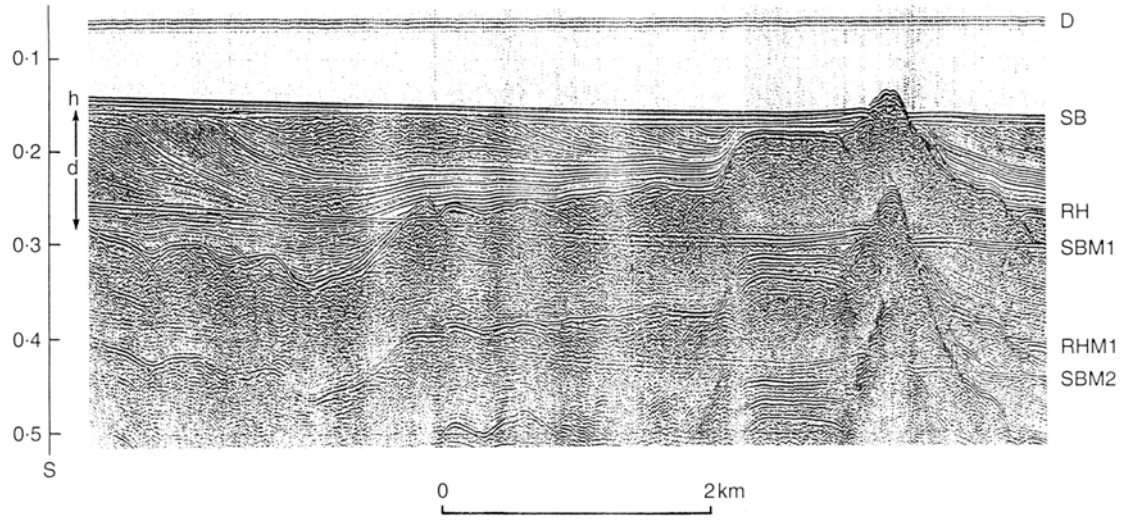
- In many seismic surveys, we are most interested in how structure varies with horizontal position and may be less interested in actual depths.

- Note that the **seismic section** is composed of many individual **traces**. A trace is the time variation of the ground motion (or water pressure in a marine survey) recorded by the receiver for a single shot.

- In this type of seismic survey the absolute depth cannot be determined. The travel time = *t* = depth/ velocity. With just one measurement of travel time, t, it is

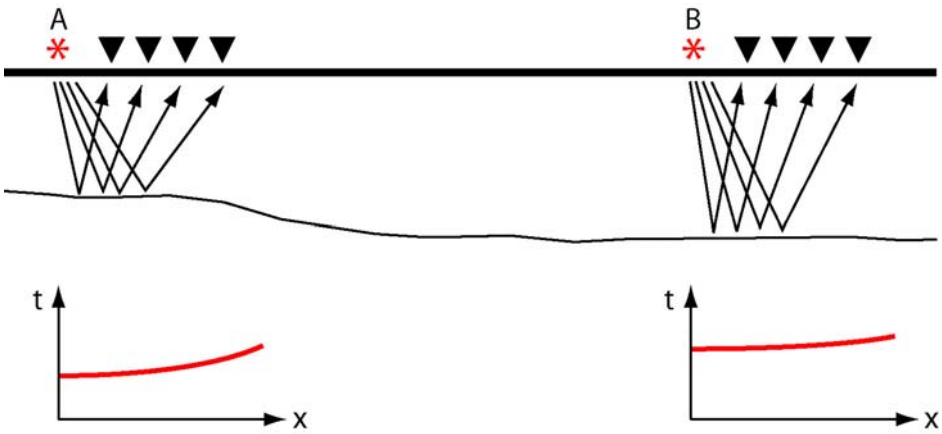
impossible to determine two unknowns. Only relative changes in depth can be determined.

- Seismic reflections are generally quite weak (low amplitude) and this technique does not generally work well on land where cultural noise levels are higher and the coupling between the geophone and the ground is variable.



- Example above is from marine seismic exploration in the Gulf of Corinth (Kearey Figure 4.56). Note that D is a direct wave where a signal travelling horizontally passes the receiver. All other arrivals have travelled vertically downwards in the Earth and back again. The seabed (SB) gives a strong reflection, and multiple reflections are quite strong (SBM1 and SBM2) and obscure other reflections from greater depth. RH is a reflection from bedrock that is exposed above the seafloor on the right side of thee profile.

C2.3.3 Multi-channel seismic profiling



- By combining the two techniques described above, we can measure both the **velocity variation with depth** and **horizontal variations in structure** on a profile.

- One simple acquisition strategy is sketched above. Note that at location 'A' the reflector is quite shallow. At location 'B' the reflector is deeper and the reflector shows a larger zero-offset travel time and less normal moveout. Analysis of these data will give estimates of both the interface depth and velocity.

- However this has the disadvantage that the energy received at each receiver has been reflected at different points. The common mid-point technique can overcome this problem. Seismic data is grouped into shot-receiver paths that share a **common reflection point**. This technique is discussed in detail in C2.5