The amplitudes of a given type of seismic wave leaving the source region may depend on the wave's direction, and this directional dependence of the seismic amplitudes is called radiation pattern. Figure 2 illustrates the idealized P wave radiation patterns of an earthquake and of an explosion. The earthquake radiation pattern features four lobes whose quadrantal orientations are determined by the direction of the fault slip. The difference in size among the lobes arises from the fault rupture propagation, as indicated by the arrow. The solid lines indicate compressional (pushing) first motion; the dashed lines indicate rarefactional (pulling) first motion. In contrast, the P waves leaving an idealized explosion source have the same amplitude in all directions, and they all have compressional first motion.

The generation of seismic waves is a complex physical phenomenon, but some simple generalizations are still possible. Seismic waves span a broad gamut of oscillation frequency. The efficiency with which low frequency (long-period) waves are produced increases with the seismic source size. A recorded seismic signal is made up of oscillatory motions of many different periods. The amplitude associated with each period may be determined using well established signal processing techniques. Two signals are said to differ in frequency content (or spectral make-up) if one is made up predominantly of low frequency (long-period) oscillations and the other of high frequency (short-period) oscillations.

Earthquakes involve motions between large rock blocks, whereas explosions are small, intense sources of short time duration. The fundamental source differences between earthquakes and explosions are manifested in the characteristics of the seismic waves they produce. Typically, explosion generated P waves feature larger, more impulsive beginnings than do their earthquake counterparts. For similar P wave strength (as measured in terms of body wave magnitude $m_b$, for example), the earthquakes tend to produce stronger long-period (low frequency) surface waves, and therefore larger surface wave magnitudes $M_S$. On a more subtle level, the spectral make-up of the seismic signals are different between the two source types, with the explosion generated ones usually showing relative enrichment towards higher frequencies. The analogy with people is that the particular vocal spectral composition makes each person's voice distinct from all others. In other words, explosions tend to have a higher "pitch" than do earthquakes.