Grain size

Introduction

The mineral portion of soil is derived from the parent material by weathering and consists of a range of particle sizes. The grain size of soil particles and their aggregate structures affect the ability of a soil to transport and retain water, air, and nutrients. Grain size is classified as clay if the particle diameter is <0.002 mm, as silt if it is between 0.002 mm and 0.06 mm, or as sand if it is between 0.06 mm and 2 mm. Soil texture refers to the relative proportions of sand, silt, and clay particle sizes, irrespective of chemical or mineralogical composition. Sandy soil is called coarse-textured, and clay-rich soil fine-textured. Loam is a textural class representing about one-fifth clay, with sand and silt sharing the remainder equally.

Grain size in soil

The following granulometric parameters were measured on soil: the fraction <0.002 mm (clay content), the fraction <0.06 mm (silt and clay content), the medium grain size (called D50%, for 50% of the cumulative frequency curve), and the sorting index, defined as the square root of the ratio D75% over D25%, referring to quartiles on the cumulative frequency curves. For each of these parameters, distribution maps were produced for subsoil and topsoil.

In subsoil, clay content is high in most of Spain, south-western and south-eastern France, the karstic area of Croatia and Slovenia (residual soils), Greece (except the north-east), most of Germany and adjacent north-eastern France, Latvia and Lithuania. Low clay content prevails in most of Fennoscandia, Scotland, and the glacial-drift area of northern continental Europe. In topsoil, the measured clay content distribution is very similar, except for somewhat lower contents in the Baltic states, showing natural depletion of clay particles in the cold and wet boreal climate.

In subsoil, clay content shows a good positive correlation with Te (0.44) and a weak positive correlation (>0.3) with Co, Ni, V, Cd and pH; clay content has a good negative correlation with SiO_2 (-0.46) and a weak negative correlation with Na_2O (-0.39).

In topsoil, clay content has a good positive correlation (>0.4) with Co, a weak positive correlation with Ni, V, Cu, Te, Mn, Zn, Y, the REE and pH; a good negative correlation with SiO_2 (-0.45) and a weak negative correlation with Na_2O (-0.38).

The subsoil distribution map of the <0.06 mm fraction (silt+clay content) shows low values in the glaciated Scandinavian countries, north European plain from the Netherlands, through north Germany and parts of Poland, and Estonia, and north-east Scotland, the lower Garonne basin in France, eastern Pyrenees, north-west Portugal, the lower Guadalquivir River basin, and central Hungary.

High values of the <0.06 mm fraction (silt+clay content) occur in the loess belt of central Europe, from northern France over Belgium into Germany, also in the Carpathians of southern Poland, Slovakia and northern Hungary, in Greece, Slovenia, western Croatia, parts of Italy, southern France and south-eastern Spain. In topsoils, the same pattern is present, but values are generally higher in Brittany (France), Wales and south-west England.

In subsoil, the <0.06 mm fraction shows a good positive correlation (>0.4) with Co, Ni, Fe, Sc, V, Cu, Te, Ti, Y and the heavy REEs; a weak positive correlation (>0.3) with Al, Ga, In, Ca, pH, Zn, Hg and the light REEs; a good negative correlation with SiO_2 (-0.558), and a weak negative correlation with Na_2O (-0.36).

In topsoil, the <0.06 mm fraction shows a good positive correlation with Co, Nb, Sc, V, Cu, Zn, In, Ti, Fe, Mn, Y and all the REEs; a weak positive correlation with Al, Ga, Ni, Cr, Ta, U, Te, Cd, Mg and pH; and a good negative correlation with SiO_2 (-0.56).

The medium grain size (D50% µm) in both subsoil and topsoil is generally coarser (above 170 µm) in glacial drift cover of Poland, northern Germany, Denmark, large areas of Finland and Sweden, and also in southern Portugal, south-western France (Garonne), and some irregularly distributed points. It is interesting to note that the medium grain size distribution map shows completely the opposite patterns of the <0.06 mm fraction map. As expected in this case, SiO_2 is positively correlated with medium grain size (0.50), whereas a large number of elements have a weak to good negative correlation (in the range -0.2 to -0.5) with the medium grain size.

The distribution maps of the sort index also show a similar distribution for subsoil and topsoil. Soil appears to be badly sorted (sort index above 3.1) in central and northern Spain, central France, north-central Poland, central-eastern Greece and Crete, southern Ireland and south-eastern England. Soil types are more homogeneous, *i.e.,* well sorted (sort index below 2.1) in most glaciated terrains of Fennoscandia, the Benelux and north-western France, northern Germany, western and southern Poland, Slovakia and Hungary.

In subsoil, only Cs has a weak correlation (0.30) with the sort index; in topsoil Al, Cs, Th and some REEs are weakly correlated, and SiO_2 has a weak negative correlation (-0.34).

Sampling site N35E10T3 in Poland.
The medium grain size (D50) in topsoil sample is 306 μm.