## Introduction

See section on Rare Earth Elements (REEs).

Table 24 compares the median concentrations of Dy in the FOREGS samples and in some reference datasets.

Table 24. Median concentrations of Dy in the FOREGS samples and in some reference data sets.

| *Dysprosium (Dy)* | *Origin – Source* | *Number of samples* | *Size fraction mm* | *Extraction* | *Median mg kg$^{-1}$* |
|---|---|---|---|---|---|
| Crust[1)] | Upper continental | n.a. | n.a. | Total | 3.9 |
| **Subsoil** | **FOREGS** | **790** | **<2.0** | **Total (ICP-MS)** | **3.66** |
| **Topsoil** | **FOREGS** | **843** | **<2.0** | **Total (ICP-MS)** | **3.42** |
| Soil[2)] | World | n.a. | n.a | Total | 2.5 |
| **Water** | **FOREGS** | **807** | **Filtered <0.45 µm** | | **0.01 (µg l$^{-1}$)** |
| Water[2)] | World | n.a. | n.a. | | 0.0072 (µg l$^{-1}$) |
| **Stream sediment** | **FOREGS** | **848** | **<0.15** | **Total (XRF)** | **4.53** |
| **Floodplain sediment** | **FOREGS** | **743** | **<2.0** | **Total (XRF)** | **3.45** |

[1)]Rudnick & Gao 2004, [2)]Ivanov 1996.

## Dy in soil

The median Dy content is 3.66 mg kg$^{-1}$ in subsoil and 3.42 mg kg$^{-1}$ in topsoil; the range varies from <0.1 to 12.7 mg kg$^{-1}$ in subsoil and from 0.18 to 44.9 mg kg$^{-1}$ in topsoil. The average ratio topsoil/subsoil is 0.919.

Dysprosium in subsoil shows low values (<2.52 mg kg$^{-1}$) throughout central and northern Finland, the glacial drift area from Poland to the Netherlands, the Paris Basin in France, central Hungary, central Portugal, southern Spain, part of east Spain, and part of east Greece.

High Dy values in subsoil (>4.96 mg kg$^{-1}$) are located mainly in the crystalline basement of the Iberian Massif in northern Portugal and north-west Spain, in the central and eastern Pyrenees, in the Italian alkaline magmatic province, in soil on karst of Slovenia and Croatia, in southern Hungary and Austria, in central Macedonia and Thrace in Greece related to felsic rocks and mineralisation, the loess/palaeoplacer area of northern France to Germany, south-western Norway, and northern Sweden (Salpeteur *et al.* 2005). Point anomalies appear in western Greece, associated with terra rossa soil and phosphorite mineralisation, and in northern Ireland near the Mourne granite.

In topsoil, the Dy pattern is very similar to that of the subsoil. Values are generally lower in Scandinavia. There is a point anomaly on Gran Canaria in alkaline basalt.

Dysprosium in soil has a strong to very strong correlation with the other REEs. The geochemical behaviour of Er is most similar to that of the other heavy REEs (Gd, Tb, Er, Ho, Tm, Lu and Yb). For more information, see the section on REEs.

## Dy in stream water

Dysprosium values in stream water range over two and a half orders of magnitude, from <0.002 to 0.79 µg l$^{-1}$ (excluding an outlier of 3.43 µg l$^{-1}$), with a median value of 0.008 µg l$^{-1}$. Dysprosium data correlate very closely with all the other lanthanides. See section on REEs for a general discussion.

Lowest Dy values in stream water (<0.003

μg $l^{-1}$) are predominantly found in central and southern Europe, under humid temperate and Mediterranean climate, in areas with high-mineralization Major-ions dominated stream water. They extend throughout most of Spain, southern and north-eastern France, south-eastern England, most of southern Italy (including Sicily and southern Sardinia) and all of northern Italy, western Slovenia, Croatia and Hungary, most of Austria, southern, western and eastern Germany, south-east of Poland, central Sweden, all of Albania and Greece. Most of the areas with lowest values are over Alpine Orogen terrains (southern Europe), whereas others (northern Germany and Poland) are on Variscan, Eastern Avalonian terrains (English-North German-Polish Caledonides) and East European Platform terrains.

Highest Dy concentrations in stream water (>0.05 μg $l^{-1}$) are predominantly found in Denmark, in southern and central Norway, and in southern Sweden and Finland. The areas of highest values are characterised by a humid and cold nordic climate and acid, low-mineralisation and DOC-dominated stream water. They occur on Precambrian terrains (mostly intrusive and metamorphic rocks). Enhanced Dy values also occur across central Fennoscandia, northern Ireland and Scotland, over the Fennoscandian and Irish-Scottish Caledonides, in France (Brittany and Massif Central) are characterised by Variscan terrains (intrusive and volcanic rocks). Highly anomalous Dy values in northern Germany are associated with high DOC values.

## Dy in stream sediment

The median Dy content in stream sediment is 4.45 mg $kg^{-1}$, and the range varies from 0.11 to 78.2 mg $kg^{-1}$.

The Dy distribution map shows low stream sediment values (<3.15 mg $kg^{-1}$) in east and north Finland, in the northern European plain on glacial drift, in western Ireland, in parts of south, east and north Spain, in north-east France (Jura), in the western Alps and the northern Apennines, in north-easternmost Italy, coastal Croatia, western and southern Greece.

The two areas with the highest Dy values in stream sediment are the Variscan part of the Iberian Peninsula, *i.e.,* north Portugal, Galicia and the Sierra de Gredos in Old Castilia (Spain), and the Massif Central in France (Variscan granite), extending into the Poitou region to the north-west. High Dy (>6.15 mg $kg^{-1}$) also occurs in south-west Norway, north Sweden and adjacent Norway, parts of south and east Sweden, a point anomaly in northern Estonia (phosphate deposits), eastern Scotland, the Bohemian Massif, with a point anomaly near the U deposit of Dolny Rozinka in the central Czech Republic, Albania, and south-eastern Austria.

Dysprosium in stream sediment has a strong to very strong correlation with Th, U and the REEs. For more information, see the section on REEs.

## Dy in floodplain sediment

Total Dy values in floodplain sediment, determined by ICP-MS, vary from 0.19 to 19.6 mg $kg^{-1}$, with a median of 3.45 mg $kg^{-1}$.

Low Dy values in floodplain sediment (<2.38 mg $kg^{-1}$) occur in northern and eastern Finland on gneiss and greenstone of the Fennoscandian Shield, the glacial drift covered plain from north Germany to Poland, and northern Ireland on crystalline and clastic rocks; the Ebro basin, Cantabria, Pyrenees, La Mancha in Spain on chiefly clastic and partly calcareous rocks; the alluvial sediments of the lower Garonne and Rhône rivers in France; north-central Austria mostly on molasse deposits; in central Greece on calcareous and clastic rocks.

High Dy values in floodplain sediment (>2.58 mg $kg^{-1}$) occur over the metamorphic and felsic igneous rocks and mineralised areas of the Precambrian Shield in northern, central and southernmost Sweden, northernmost and south-west Finland, and almost the whole of Norway; on glacial outwash cover in Estonia, where there may also be an association with phosphorite mineralisation. High Dy values in floodplain sediment occur in France over the Massif Central on felsic crystalline rocks, and north part of the Paris basin on mostly carbonate rocks; in northern

Portugal and Galicia, and Sierra Morena in southern Spain they are associated with felsic rocks and mineralisation; in central Swiss-Italian Alps with felsic intrusives and mineralisation, and the Roman Alkaline Province; an extensive area with felsic rocks and mineralisation begins from the Ardennes to the Harz Mountains, Erzgebirge, Bohemian Massif to Brno (Li deposits) in the Czech Republic and ends in north-eastern Austria on Tertiary and Quaternary sediments; southern Austria with felsic intrusives; high Dy values in floodplain sediment of Slovenia and Croatia, except Dalmatia, are explained by possible concentration in karstic soil; in eastern Hungary the Dy anomalous values are probably due to the mineralisation in the Apuseni Mountains in neighbouring Romania.

In conclusion, granite, granodiorite, shale, sandstone and schist lithologies show the highest Dy concentrations in floodplain sediment, and the glacial drift covered terrain (north-east Germany and Poland) the lowest; low Dy contents are also generally found in calcareous areas (*e.g.,* eastern Spain, Greece and Dalmatian coast), except where there is intense development of residual soil in karst terrain (*e.g.,* Slovenia and Croatia). The distribution map of total Dy in floodplain sediment shows, therefore, the geochemical differences of the geological substratum and mineralised areas quite well, and no distinguishable influences from anthropogenic activities are recognised. It is noted that the spatial distribution of Dy is similar to that of other HREEs (Er, Gd, Ho, Lu, Tb, Tm, Yb).