

## Separation of heavy metals and some elements by factor analysis in Manavgat– Alanya beach sands, Antalya, Turkey

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The Antalya-Manavgat coast line in Antalya is part of the Part of the Mediterranean shore line. This area is mostly covered with beach sand sediments and is a huge attraction to tourist every summer. For the purpose of mitigating environmental pollution, factor analysis (Principal Component Analysis – PCA, SPSS Statistics Software-21) was applied to the heavy metals (Zn, V, Al, Ba, Cu, Ti, Pb, Co, Ni, Mn, W, Mo, Sb, Cr, Mg, Cd and As, together with Zr, Hf, Bi, Te, Sr, Y and Sn) present in the beach sand samples collected from 44 different sampling stations along the beach area, to determine whether their sources are geogenic or anthropogenic.

In the Extraction Sum of Square loadings, 3 factors retained are same as the Initial Eigenvalues; implying that there is no difference between the common variance and the total variance of the factors. Or there is no difference in the variable's variance. According to the results of the PCA, the 3 factors retained explain 72.234% of the 37 variable's variance. Zn (0.928), V (0.928), Al(0.923), Ba(0.884), Cu(0.832), Ti(0.823), Pb (0.820), Co(.767), Ni(.766), Mn(.640), W(.582), Mo (.544), Sb (.465), Cr (.452) and Mg (.371) were attributed to be from a geogenic source and they relate to the first Principal Component known as the Geogenic Component. Whereas elements such as– Zr (.631), Hf (.559), Bi (.438), Te (.524) and Sr (.650) and Cd (.341) of second and As (.701), Y (.515) and Sn (.356) of the third – principal components with high positive correlation were attributed to anthropogenic sources. Both components (two and three) are called as the anthropogenic components.

The beach sand sediments are also thought to have some level of anthropogenic contamination by Cu, Pb, Co, Mn, Sb and Mg as expressed by their positive significant correlation in the third component, and Ti, W, Cd and As in the second component. Additional research work in other beach areas of the region would enrich the reasons for recommending such quality standards for Beach Sands.