Data Article

Data on heavy metal and magnetic relationships in coastal sediments from South East Coast of Tamilnadu, India

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A B S T R A C T

In this data, the heavy metal concentration and magnetic susceptibility in coastal sediment samples collected from Periyakalapet to Parangipettai of East Coast of Tamilnadu using Energy Dispersive X-ray Fluorescence (EDXRF) technique and dual frequency susceptibility meter. We aimed to (i) determine the heavy metal concentration in the sediments from Periyakalapet to Parangipettai of East Coast of Tamilnadu (ii) assess the magnetic mineral property of sediments (iii) study the correlation between heavy metal and magnetic susceptibility. The determined heavy metal concentration found in the order of Mn > Ba > V > Cr > Zn > La > Ni > Pb > Co > As > Cd > Cu > Al > Fe > Ca > Ti > K > Mg. The magnetic susceptibility (χlf) measurements show that they vary from 5.92×10⁻⁸ m³ kg⁻¹ to 29.06×10⁻⁸ m³ kg⁻¹ with an average of 20.39×10⁻⁸ m³ kg⁻¹. Analysed data confirmed that magnetic susceptibility has the potential tool to indicate the heavy metal pollution sources.

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**Specifications Table**

| Subject area               | Physics                                                                 |
|----------------------------|-------------------------------------------------------------------------|
| More specific subject area | Heavy metal and magnetic measurements                                   |
| Type of data               | Table                                                                   |
| How data was acquired      | Energy Dispersive X-ray Fluorescence Spectrometer (EDXRF) and Dual frequency susceptibility meter. |
| Data format                | Raw data                                                                |
| Experimental factors       | The sediment samples were oven dried at 105 °C for 2 h to become a constant weight and grounded into a fine powder using an agate mortar and pestle. Then powder samples were sieved using a < 63 μm sieve and stored in desiccators to remove traces of water from the sample until they were analyzed. One gram of the fine ground sample and 0.5 g of boric acid (H₃BO₃) was mixed. The mixture was thoroughly ground and pressed to a pellet of 25 mm diameter using a hydraulic press (20 t) for EDXRF analysis. The dried samples were then sieved using a 1 mm sieve mesh to remove particles such as glass, plant debris, refuse and small stones. The sieved samples were stored in a plastic container for further laboratory measurements. The magnetic susceptibility measurements were then carried out on the sieved samples packaged in a 10 ml plastic container at laboratory temperature. Measurements of magnetic susceptibility were made at both low (0.465 kHz) and high (4.65 kHz) frequencies using MS2B dual frequency susceptibility meter linked to a computer operated using a Multisus2 software. |
| Data source location       | Periyakalapet to Parangaipeattai, East Coast of Tamilnadu, India        |
| Data accessibility         | Data is with this article.                                              |

**Value of the data**

- Data presented on the heavy metals concentration, in sediments can be useful to draw a base line data in marine environment.
- Data shown here used as a tool for anthropogenic causes in heavy metal content and to identify common pollution sources.
- Data shows that continuous monitoring and efforts of remediation might be required to improve the coastal environment near industrialized areas.

1. **Data**

The concentration of elements in sediments from Periyakalapet to Parangaipeattai along the East Coast of Tamilnadu is presented in Table 1. The concentration (mg/kg) varies from 20 to 4200; 15800–27900; 7200–9500; 5800–12500; 376–9889; 3215–21836; 22.7–162.2; 19.2–61.9; 61.4 – 386.9; 11–71; 16.3–25.8; 22.7 –121.9; 4.7–8.4; 0.2–13.7; 302.9–485.2; 1.1-123 and 2.3 -25.8 for Mg, Al, K, Ca, Ti, Fe, V, Cr, Mn, Co, Ni, Zn, As, Cd, Ba, La, Pb respectively. The mean concentration values
Table 1
Heavy metal concentration of the sediment samples along the study area.

| S. No | Element | Mg ppm | Al ppm | K ppm | Ca ppm | Ti ppm | Fe ppm | V ppm | Cr ppm | Mn ppm | Co ppm | Cu ppm | Zn ppm | Cd ppm | Ba ppm | La ppm | Pb ppm |
|-------|---------|--------|--------|-------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 1     | PKP     | 2223   | 20696  | 6615  | 8943   | 2039   | 9534   | 50.11 | 42.38  | 192.26 | 3.38   | 20.86  | BDL    | 30.54  | 5.5    | 312.4  | 12.9   | 4.4    |
| 2     | EPC     | 25     | 20255  | 6202  | 7239   | 2340   | 8458   | 50.9  | 30.3   | 180.1  | 2.8    | 19.8   | BDL    | 23.0   | 2.1    | 306.1  | 29.1   | 1.5    |
| 3     | ARV     | 1800   | 37425  | 5484  | 8070   | 51434  | 7110   | 207.3 | 1387.6 | 19.0   | 24.4   | BDL    | 89.0   | BDL    | 180.2  | 216.7  | 35.7   |
| 4     | NDK     | 300    | 133532 | 6800  | 4592   | 530    | 3647   | 23.4  | 12.5   | 68.1   | 1.1    | 15.2   | BDL    | 14.0   | BDL    | 411.9  | BDL    | BDL    |
| 5     | MTP     | 1028   | 19066  | 7869  | 7406   | 1216   | 5520   | 26.37 | 21.21  | 110.05 | 1.88   | 16.48  | BDL    | 20.16  | 10.2   | 385.4  | BDL    | 1.4    |
| 6     | VMP     | 6007   | 30893  | 5044  | 20809  | 15464  | 35269  | 234.71| 127.00 | 750.16 | 12.51  | 33.63  | BDL    | 62.31  | 3.4    | 209.0  | 47.0   | 17.0   |
| 7     | NVD     | 3022   | 26895  | 4468  | 21176  | 11689  | 33771  | 204.56| 123.33 | 748.38 | 11.95  | 33.30  | BDL    | 65.67  | BDL    | 152.3  | 31.0   | 19.8   |
| 8     | NRB     | 5051   | 31132  | 4850  | 21679  | 19539  | 40489  | 310.87| 155.77 | 869.09 | 14.35  | 30.23  | 3.60   | 65.94  | BDL    | 176.0  | 51.2   | 25.5   |
| 9     | TAZ     | 816    | 21212  | 6085  | 12057  | 3357   | 13407  | 64.94 | 54.52  | 243.11 | 5.01   | 23.21  | BDL    | 30.78  | 1.4    | 256.7  | 19.1   | 9.1    |
| 10    | COT     | 1608   | 19866  | 5392  | 11628  | 3776   | 13137  | 71.38 | 55.33  | 263.74 | 4.61   | 24.59  | BDL    | 29.00  | 3.6    | 236.1  | 6.4    | 6.1    |
| 11    | RSP     | 795    | 23554  | 7286  | 11363  | 931    | 8308   | 31.85 | 43.85  | 157.81 | 3.10   | 22.84  | BDL    | 22.47  | 2.3    | 308.2  | BDL    | 6.8    |
| 12    | STP     | 1773   | 22928  | 9350  | 11586  | 724    | 6693   | 28.12 | 30.32  | 128.35 | 2.40   | 21.67  | BDL    | 36.02  | 1.8    | 416.8  | 1.0    | 7.6    |
| 13    | BLD     | 2072   | 20975  | 7147  | 9403   | 1583   | 9530   | 40.01 | 66.16  | 185.61 | 3.42   | 23.16  | BDL    | 25.08  | 3.8    | 302.5  | 3.1    | 5.5    |
| 14    | SYP     | 3440   | 21775  | 4859  | 13169  | 3469   | 19281  | 86.6  | 112.3  | 112.3  | 6.5    | 32.1   | BDL    | 37.8   | 5.1    | 250.4  | 18.0   | 5.0    |
| 15    | PGP     | 4612   | 25167  | 5232  | 12027  | 8814   | 24594  | 151.9 | 118.1  | 118.1  | 8.3    | 30.4   | BDL    | 45.0   | 2.8    | 224.0  | 6.0    | 9.4    |
| **Average** |       | 2305   | 23691  | 6179  | 12076  | 8460   | 19302  | 139.11| 80.03  | 367.65 | 6.68   | 24.80  | 3.60   | 39.79  | 3.8    | 275.2  | 36.8   | 11.1   |
Table 2
Low Frequency Susceptibility (IF) (10⁻⁸ m³/kg), High Frequency Susceptibility (HF) (10⁻⁸ m³/kg) and Frequency dependent susceptibility (FD) %.

| Location ID | $\chi_{\text{LF}}$ | $\chi_{\text{HF}}$ | $\chi_{\text{FD}}$ (%) |
|-------------|-----------------|-----------------|-----------------|
| PKP         | 58.00           | 56.67           | 2.30            |
| EPC         | 17.67           | 15.50           | 12.26           |
| ARV         | 815.25          | 810.50          | 0.58            |
| NDK         | 20.75           | 20.17           | 2.81            |
| MTP         | 31.50           | 30.25           | 3.97            |
| VMP         | 17.33           | 12.83           | 25.96           |
| NVD         | 9.42            | 7.83            | 16.81           |
| NRB         | 7.75            | 7.42            | 4.30            |
| TZK         | 9.75            | 6.92            | 29.06           |
| COT         | 10.92           | 8.00            | 26.72           |
| RSP         | 5.92            | 5.67            | 4.23            |
| STP         | 7.67            | 7.33            | 4.35            |
| BLN         | 26.92           | 26.42           | 1.86            |
| SYP         | 6.92            | 6.75            | 2.41            |
| PGP         | 23.17           | 22.00           | 5.04            |
| Average     | 71.26           | 69.62           | 9.51            |

Fig. 1. Locations Vs Low Frequency Susceptibility (IF).

Fig. 2. Locations Vs High Frequency Susceptibility (HF).
of heavy metals in sediments do not exceed the natural background levels of heavy metals given by Turekian and Wedepohl (1961) [1]. This indicates that study area dominated with large amount of natural sediment with low heavy metal content [2]. Table 2 shows Low Frequency Susceptibility (IF) \(10^{-8} \text{ m}^3/\text{kg}\), High Frequency Susceptibility (HF) \(10^{-8} \text{ m}^3/\text{kg}\) and Frequency dependent susceptibility (FD) % and Figs. 1 and 2 shows the location Vs Low Frequency (\(\chi_{lf}\)) and high frequency Susceptibility (\(\chi_{hf}\)).

Percent Frequency-dependent susceptibility (\(\chi_{fd}\))% is a diagnostic tool to know the proportion of superparamagnetic grains in sediments [3]. Low value of \(\chi_{fd}\)% indicates that the magnetic properties of the samples are predominately contributed by the coarse multi-domain (MD) grains, rather than by the super-paramagnetic (SP) particles. Fig. 3 shows Location Vs percent frequency dependent susceptibility.

The correlation between the magnetic susceptibility and the heavy metal concentrations is given in Table 3. The correlation between magnetic concentration related parameters and heavy metals content reveals a causal relation between ferromagnetic oxide and heavy metals in samples. This relationship could be due to that fact that heavy metal elements are incorporated into the lattice structure of the ferromagnetic during combustion process or are adsorbed onto surface of pre-present ferrimagnetics in the environments [4].

2. Experimental design, materials and methods

2.1. Study area description

The present study area covers from Periyakalapet (N:12° 1’ 46.6320’’ E:79° 51’ 49.0032’’) to Parangaipettai (N:11° 30’ 0.0000’’ E:79° 46’ 0.0012’’), East coast of Tamil Nadu. The location map of the study area is given in Fig. 4. The area between Periyakalapet and Parangipettai are represented by both depositional and erosional nature like deltaic alluvial plains, cheniers, paleo lagoonal plains and strandlines, coastal sand dunes, beaches, beach cliffs, paleo-barrier, paleotidal flats and mud flats, river mouth bars, abandoned river channels and natural levees. The beach and strandlines plain border in the west by Canaries with intervening Paleo-lagoonal plain. The principal rivers in the study area are the River Gadilam and Uppanar.

2.2. Sample collections

Sediment samples are collected from 15 locations along Periyakalapet to Parangaipettai Coast of Tamilnadu using a Peterson grab sampler. The grab sampler collects 10 cm thick bottom sediment layer from the seabed along the 15 locations during the pre monsoon period. Table 4 shows the geographic coordinates of the sampling locations. Garmin oregon 550, hand held Global Positioning System (GPS) was utilized for identifying the sampling locations [5–8]. The collected samples were
Table 3
Correlation matrix between heavy metals and magnetic parameters in sediments, Coastal area, Tamilnadu.

| Variables | Mg  | Al  | K    | Ca   | Ti   | Fe   | V    | Cr   | Mn   | Ni   | Zn   | As   | Cd   | Ba   | La   | Pb   | χLF | χFD |
|-----------|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Mg        | 1   |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Al        | 0.580 | 1 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| K         | 0.557 | −0.559 | 1 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Ca        | 0.300 | 0.872 | −0.429 | 0.197 | 1 |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Ti        | 0.587 | 0.933 | −0.657 | 0.536 | 0.921 | 1 |      |      |      |      |      |      |      |      |      |      |      |      |
| Fe        | 0.340 | 0.886 | −0.469 | 0.244 | 0.998 | 0.941 | 1 |      |      |      |      |      |      |      |      |      |      |      |
| V         | 0.657 | 0.905 | −0.691 | 0.545 | 0.862 | 0.972 | 0.888 | 1 |      |      |      |      |      |      |      |      |      |      |
| Cr        | 0.393 | 0.898 | −0.503 | 0.455 | 0.931 | 0.940 | 0.940 | 0.853 | 1 |      |      |      |      |      |      |      |      |      |
| Mn        | 0.614 | 0.936 | −0.669 | 0.582 | 0.901 | 0.998 | 0.923 | 0.970 | 0.939 | 1 |      |      |      |      |      |      |      |      |
| Ni        | 0.842 | 0.611 | −0.736 | 0.854 | 0.320 | 0.641 | 0.368 | 0.727 | 0.439 | 0.667 | 1 |      |      |      |      |      |      |      |
| Zn        | 0.608 | 0.945 | −0.570 | 0.592 | 0.884 | 0.977 | 0.906 | 0.940 | 0.929 | 0.978 | 0.663 | 1 |      |      |      |      |      |      |
| As        | 0.577 | 0.902 | −0.334 | 0.649 | 0.755 | 0.841 | 0.771 | 0.771 | 0.870 | 0.857 | 0.506 | 0.872 | 1 |      |      |      |      |      |
| Cd        | 0.049 | 0.361 | 0.299 | −0.270 | −0.403 | −0.434 | −0.420 | −0.380 | −0.463 | −0.439 | −0.236 | −0.437 | −0.410 | 1 |      |      |      |
| Ba        | 0.004 | −0.730 | 0.883 | −0.687 | −0.610 | −0.821 | −0.646 | −0.844 | −0.706 | −0.837 | −0.816 | −0.778 | −0.614 | 0.364 | 1 |      |      |
| La        | 0.117 | 0.790 | −0.340 | 0.035 | 0.970 | 0.830 | 0.959 | 0.761 | 0.878 | 0.803 | 0.179 | 0.791 | 0.650 | 0.371 | 0.505 | 1 |      |
| Pb        | 0.469 | 0.943 | −0.487 | 0.518 | 0.920 | 0.959 | 0.935 | 0.906 | 0.964 | 0.961 | 0.527 | 0.961 | 0.905 | −0.516 | −0.739 | 0.837 | 1 |
| χLF       | −0.083 | 0.628 | −0.130 | −0.237 | 0.888 | 0.657 | 0.864 | 0.600 | 0.716 | 0.617 | −0.043 | 0.618 | 0.442 | −0.250 | −0.295 | 0.945 | 0.683 | 1 |
| χFD       | 0.096 | 0.005 | −0.347 | 0.393 | −0.104 | 0.039 | −0.100 | 0.037 | 0.073 | 0.070 | 0.283 | 0.046 | 0.087 | −0.115 | −0.344 | −0.119 | 0.018 | −0.264 | 1 |

Note: Bold values indicates significant correlation between variables
immediately transferred to polythene bags and refrigerated at 4 °C until analysis. The samples are taken to the laboratory, dried at room temperature and sieved to remove large fractions with a 1×1 mm nylon sieve [9,10]. Then samples were oven dried at 105 °C for 2 h to a constant weight and sieved through 63 μm sieve since heavy metals are most often associated with small grains [8,11]. The samples were then grinded to a fine powder using an agate mortar. All powder samples were stored in a desiccator until they were analyzed.

Table 4
Latitude and longitude value of study area.

| S. No | Location ID | Name of the Location | Latitude (N) | Longitude (E) |
|-------|-------------|----------------------|--------------|---------------|
| 1     | PKP         | Periyakalapet        | 12° 1’ 46.6320“ | 79° 51’ 49.0032“ |
| 2     | EPC         | Ellaipillaiachavady  | 11° 55’ 54.0228“ | 79° 48’ 19.1268“ |
| 3     | ARV         | Auroville            | 11° 59’2.8422“ | 79° 50’55.5334“ |
| 4     | NDK         | Nadukuppam           | 11° 58’1.7401“ | 79° 38’35.5103“ |
| 5     | MTP         | Muthialpet           | 11° 57’ 18.2556“ | 79° 50’ 4.1712“ |
| 6     | VMP         | Veerampattinam       | 11° 54’ 5.6160“ | 79° 49’ 36.7428“ |
| 7     | NVD         | Nallavodu            | 11° 51’ 27.6014“ | 79° 34’ 27.46“ |
| 8     | NRB         | Narambai             | 11° 49’ 3.2520“ | 79° 48’ 0.9216“ |
| 9     | TZK         | Thazhankuda          | 11° 46’14.2020“ | 79° 47’40.5605“ |
| 10    | COT         | Cuddalore OT         | 11° 45’ 0.0000“ | 79° 45’ 0.0000“ |
| 11    | RSP         | Raasapettai          | 11° 40’ 56.2692“ | 79° 46’ 17.5008“ |
| 12    | STP         | Sitheripettai        | 10° 30’ 31.6944“ | 77° 13’ 17.7600“ |
| 13    | BLD         | Betlodai             | 11° 21’ 45.2300“ | 79° 32’ 21.8544“ |
| 14    | SYP         | Samiyarpettai        | 11° 32’ 57.2100“ | 79° 45’ 31.8744“ |
| 15    | PGP         | Parangaipettai       | 11° 30’ 0.0000“ | 79° 46’ 0.0012“ |

Fig. 4. Location map of the Study Area.
2.3. Magnetic susceptibility (χ) measurements

The samples were air dried at room temperature to reduce the mass contribution of water and to avoid any chemical reactions. They were then sieved using a 1 mm sieve mesh to remove particles such as glass, plant debris, refuse and small stones [12]. The sieved samples were stored in a plastic container for further laboratory measurements. The magnetic susceptibility measurements were then carried out on the sieved samples packaged in a 10 ml plastic container at laboratory temperature. Measurements of magnetic susceptibility were made at both low (0.465 kHz) and high (4.65 kHz) frequencies using MS2B dual frequency susceptibility meter linked to a computer operated using a Multisus 2 software. All measurements were conducted in the 1.0 sensitivity settings. Each sample was measured five times in two different frequencies (low and high) and an average is calculated. For natural samples which generally exhibit a continuous and nearly constant grain size distribution, can be used as a proxy for relative changes in concentration in pedogenic finned–grained magnetic particles [13]. Hence percent-frequency dependent susceptibility (χfd%) was calculated from the expression [14].

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\chi_{fd}(\%) = \left( \frac{\chi_{lf} - \chi_{hf}}{\chi_{lf}} \right) \times 100
\]

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Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2017.11.056.

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