Factors affecting the bleaching performance of thermally activated palygorskite and palygorskite-smectite clays from the Ventzia Basin, west Macedonia, Greece

K. Vythoulkas1, M. Stamatakis2, M. Pozo3, and A. Argyraki4

1 Geohellas S.A., 17564 Athens, Greece

2 National and Kapodistrian University of Athens, Department of Geology and Geoenvironment, 15784 Athens, Greece

3 Universidad Autόnoma de Madrid, Department of Geology and Geochemistry, 28049 Spain

4 National and Kapodistrian University of Athens, Department of Geology and Geoenvironment, 15784 Athens, Greece

Corresponding author: K. Vythoulkas, ORCID: 0009-0000-7604-1755, email: [kvythoulkas@geohellas.com](mailto:kvythoulkas@geohellas.com)

**SUPPLEMENTARY MATERIAL**

Table S1. Semi-quantitative (XRD%) mineralogical compositions of study samples (*n* = 70).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample id | XRD% of the bulk sample | | | | | | XRD% of the clay fraction (<2 μm) | | | | | | | |
| Sme | Plg | Srp | Qz | Cal | Dol | Sme | Plg | Ilt | Tlc | Srp | Chl | Kln | Sep |
| GK66/02 | 44 | 20 | 20 | 16 | 0 | 0 | 65 | 33 |  |  | tr | 2 |  |  |
| GK66/05 | 45 | 37 | 8 | 10 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK66/07 | 39 | 44 | 7 | 10 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK66/08 | 19 | 43 | 31 | 7 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK66/09 | 22 | 30 | 42 | 6 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK66/11 | 16 | 31 | 22 | 31 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK66/12 | 6 | 40 | 51 | 3 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK66/13 | 13 | 52 | 27 | 8 | 0 | 0 | 2 | 97 |  |  | 0.5 | 0.5 |  |  |
| GK66/14 | 8 | 68 | 18 | 6 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK66/15 | 20 | 49 | 23 | 8 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK66/18 | 23 | 9 | 65 | 3 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK135/01 | 40 | 34 | 13 | 11 | 1 | 1 |  |  |  |  |  |  |  |  |
| GK135/03 | 38 | 36 | 15 | 11 | 0 | 0 | 50 | 47 |  | 1 |  | 2 |  |  |
| GK135/05 | 27 | 50 | 14 | 9 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK135/08 | 18 | 31 | 47 | 3 | 1 | 0 |  |  |  |  |  |  |  |  |
| GK135/09 | 28 | 42 | 24 | 5 | 0 | 1 |  |  |  |  |  |  |  |  |
| GK135/10 | 26 | 55 | 10 | 9 | 0 | 0 |  |  |  |  |  |  |  |  |
| GK135/12 | 31 | 24 | 33 | 12 | 0 | 0 |  |  |  |  |  |  |  |  |
| GP325/01 | 14 | 25 | 7 | 16 | 23 | 15 |  |  |  |  |  |  |  |  |
| GP325/02 | 35 | 19 | 5 | 38 | 0 | 3 | 80 | 12 | 3 |  | 2 | 3 |  |  |
| GP325/03 | 24 | 47 | 4 | 23 | 2 | 0 | 52 | 45 |  |  |  | 3 |  |  |
| GP325/04 | 11 | 76 | 0 | 12 | 0 | 1 | 17 | 81 | tr |  |  |  | 2 |  |
| GP327/01 | 8 | 51 | 3 | 5 | 0 | 33 |  |  |  |  |  |  |  |  |
| GP327/03 | 11 | 25 | 4 | 25 | 0 | 35 |  |  |  |  |  |  |  |  |
| GP327/05 | 14 | 55 | 4 | 27 | 0 | 0 |  |  |  |  |  |  |  |  |
| GP327/06 | 15 | 49 | 9 | 24 | 0 | 3 |  |  |  |  |  |  |  |  |
| GP327/08 | 6 | 84 | 0 | 9 | 1 | 0 |  |  |  |  |  |  |  |  |
| GP327/09 | 12 | 64 | 4 | 18 | 1 | 1 |  |  |  |  |  |  |  |  |
| GP327/11 | 14 | 67 | 3 | 16 | 0 | 0 |  |  |  |  |  |  |  |  |
| GP327/12 | 13 | 70 | 3 | 14 | 0 | 0 |  |  |  |  |  |  |  |  |
| GP327/13 | 9 | 76 | 1 | 14 | 0 | 0 |  |  |  |  |  |  |  |  |
| GP327/14 | 10 | 72 | 3 | 15 | 0 | 0 |  |  |  |  |  |  |  |  |
| GP327/16 | 39 | 15 | 7 | 39 | 0 | 0 |  |  |  |  |  |  |  |  |
| GP327/20 | 27 | 26 | 9 | 38 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM30/03 | 10 | 83 | 3 | 4 | 0 | 0 | tr | 99.5 |  |  | 0.5 |  |  | tr |
| GM30/06 | 67 | 4 | 19 | 10 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM30/09 | 29 | 66 | 2 | 3 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM30/10 | 39 | 50 | 4 | 7 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM30/11 | 44 | 48 | 2 | 6 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM30/13 | 56 | 33 | 8 | 3 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM30/17 | 46 | 48 | 4 | 2 | 0 | 0 | 29 | 71 |  |  | tr |  |  |  |
| GM30/18 | 78 | 14 | 7 | 1 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM30/19 | 79 | 14 | 6 | 1 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM30/20 | 48 | 40 | 10 | 2 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM30/21 | 71 | 7 | 21 | 1 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM30/23 | 89 | 8 | 3 | 0 | 0 | 0 | 80 |  |  |  | tr |  |  | 20 |
| GM81/02 | 63 | 26 | 11 | 0 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM81/04 | 68 | 24 | 7 | 1 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM81/06 | 65 | 25 | 7 | 0 | 0 | 3 |  |  |  |  |  |  |  |  |
| GM81/07 | 68 | 22 | 10 | 0 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM81/14 | 61 | 32 | 7 | 0 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM81/15 | 62 | 28 | 10 | 0 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM81/21 | 73 | 18 | 8 | 1 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM81/23 | 76 | 15 | 8 | 1 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM81/29 | 77 | 12 | 8 | 3 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM81/31 | 86 | 4 | 8 | 2 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM81/34 | 33 | 13 | 21 | 0 | 0 | 33 |  |  |  |  |  |  |  |  |
| GM81/35 | 79 | 8 | 6 | 1 | 1 | 5 |  |  |  |  |  |  |  |  |
| GM81/39 | 82 | 10 | 7 | 1 | 0 | 0 |  |  |  |  |  |  |  |  |
| GM81/42 | 88 | 5 | 7 | 0 | 0 | 0 |  |  |  |  |  |  |  |  |
| GL68/02 | 76 | 6 | 5 | 13 | 0 | 0 | 96 |  |  | 0.5 | 2.5 | 1 |  |  |
| GL68/03 | 39 | 20 | 12 | 12 | 17 | 0 |  |  |  |  |  |  |  |  |
| GL68/06 | 28 | 9 | 4 | 4 | 5 | 50 |  |  |  |  |  |  |  |  |
| GL68/07 | 63 | 16 | 6 | 14 | 0 | 1 |  |  |  |  |  |  |  |  |
| GL68/10 | 67 | 21 | 8 | 4 | 0 | 0 |  |  |  |  |  |  |  |  |
| GL68/12 | 15 | 77 | 6 | 1 | 1 | 0 | 18 | 79 |  | 0.5 | 2 | 0.5 |  |  |
| GL68/15 | 21 | 57 | 4 | 1 | 1 | 16 |  |  |  |  |  |  |  |  |
| GL68/17 | 18 | 69 | 3 | 1 | 0 | 9 |  |  |  |  |  |  |  |  |
| GL68/20 | 49 | 43 | 3 | 1 | 0 | 4 | 52 | 45.5 |  | 0.5 | 2 |  |  |  |
| GL68/28 | 77 | 6 | 12 | 3 | 1 | 1 |  |  |  |  |  |  |  |  |

Sme = smectite, Plg = palygorskite, Srp = serpentine, Qz = quartz, Cal = calcite, Dol = dolomite, Ilt = illite, Tlc = talc, Chl = chlorite, Kln = kaolinite, Sep = sepiolite, tr = trace. GK = Knidi borehole, GP = Pilori borehole, GM = Harami borehole, GL = Velanida borehole. Mineral abbreviations adapted from Warr (2021).

Table S2. Chemical composition of study samples (*n* = 70).

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample id | SiO2 | Al2O3 | CaO | Fe2O3 | K2O | MgO | MnO | Na2O | TiO2 | LOI | NIR*x* | NIR*y* |
| % | % | % | % | % | % | % | % | % | % |  |  |
| GK66/02 | 55.7 | 7.7 | 0.39 | 12.5 | 0.68 | 10.7 | 0.21 | 0.26 | 0.39 | 10.2 | 0.35 | 0.11 |
| GK66/05 | 53.0 | 7.1 | 0.87 | 11.2 | 0.50 | 13.4 | 0.16 | 0.12 | 0.36 | 12.1 | 0.33 | 0.20 |
| GK66/07 | 56.6 | 6.3 | 0.25 | 9.4 | 0.40 | 14.0 | 0.10 | 0.09 | 0.29 | 11.8 | 0.39 | 0.59 |
| GK66/08 | 54.4 | 5.7 | 0.36 | 10.7 | 0.36 | 15.1 | 0.66 | 0.11 | 0.29 | 11.1 | 0.45 | 0.24 |
| GK66/09 | 54.2 | 5.5 | 0.34 | 9.9 | 0.33 | 16.9 | 0.14 | 0.09 | 0.27 | 11.0 | 0.42 | 0.37 |
| GK66/11 | 58.1 | 9.7 | 0.39 | 9.0 | 0.96 | 10.7 | 0.11 | 0.35 | 0.53 | 9.4 | 0.33 | 0.11 |
| GK66/12 | 49.6 | 2.6 | 0.34 | 11.4 | 0.09 | 22.6 | 0.19 | 0.08 | 0.11 | 12.1 | 0.62 | 0.35 |
| GK66/13 | 54.1 | 4.6 | 0.34 | 10.5 | 0.32 | 18.0 | 0.19 | 0.08 | 0.25 | 10.9 | 0.56 | 0.34 |
| GK66/14 | 54.9 | 4.6 | 0.33 | 10.2 | 0.25 | 16.1 | 0.33 | 0.03 | 0.25 | 11.3 | 0.54 | 0.26 |
| GK66/15 | 55.1 | 4.5 | 0.40 | 11.2 | 0.26 | 16.8 | 0.12 | 0.03 | 0.24 | 10.2 | 0.53 | 0.41 |
| GK66/18 | 47.3 | 2.4 | 0.29 | 12.7 | 0.13 | 23.8 | 0.13 | 0.13 | 0.08 | 11.8 | 0.57 | 0.49 |
| GK135/1 | 57.0 | 6.0 | 0.33 | 10.7 | 0.40 | 13.4 | 0.20 | 0.13 | 0.30 | 10.4 | 0.38 | 0.31 |
| GK135/3 | 55.9 | 7.2 | 0.75 | 10.6 | 0.50 | 12.6 | 0.13 | 0.13 | 0.36 | 10.8 | 0.37 | 0.42 |
| GK135/5 | 55.5 | 7.0 | 0.37 | 11.1 | 0.39 | 12.9 | 0.21 | 0.11 | 0.35 | 10.9 | 0.43 | 0.25 |
| GK135/8 | 52.6 | 4.0 | 0.29 | 12.1 | 0.21 | 17.5 | 0.12 | 0.05 | 0.18 | 11.5 | 0.61 | 0.26 |
| GK135/9 | 54.6 | 6.0 | 0.27 | 11.7 | 0.31 | 14.3 | 0.08 | 0.05 | 0.29 | 11.1 | 0.52 | 0.23 |
| GK135/10 | 57.1 | 6.1 | 0.23 | 11.0 | 0.31 | 13.0 | 0.06 | 0.06 | 0.30 | 10.6 | 0.45 | 0.39 |
| GK135/12 | 53.2 | 4.7 | 0.27 | 13.0 | 0.29 | 15.9 | 0.27 | 0.07 | 0.21 | 10.7 | 0.54 | 0.43 |
| GP325/01 | 41.9 | 8.4 | 12.0 | 8.3 | 1.16 | 7.8 | 0.12 | 0.25 | 0.40 | 19.0 |  |  |
| GP325/02 | 55.6 | 11.3 | 1.65 | 11.6 | 1.53 | 7.2 | 0.07 | 0.44 | 0.54 | 9.4 | 0.34 | 0.04 |
| GP325/03 | 57.1 | 12.0 | 0.34 | 10.2 | 1.28 | 7.2 | 0.05 | 0.22 | 0.56 | 10.5 | 0.32 | 0.16 |
| GP325/04 | 57.5 | 10.8 | 0.38 | 9.4 | 1.05 | 8.0 | 0.06 | 0.22 | 0.50 | 11.7 | 0.34 | 0.06 |
| GP327/01 | 41.1 | 6.9 | 9.78 | 7.2 | 0.65 | 11.7 | 0.10 | 0.12 | 0.31 | 21.6 |  |  |
| GP327/03 | 46.6 | 9.1 | 6.67 | 8.9 | 1.45 | 9.7 | 0.14 | 0.30 | 0.45 | 16.1 |  |  |
| GP327/05 | 58.0 | 11.2 | 0.65 | 10.8 | 1.37 | 6.7 | 0.09 | 0.32 | 0.54 | 9.7 |  |  |
| GP327/06 | 57.6 | 11.8 | 0.67 | 9.5 | 1.30 | 7.2 | 0.06 | 0.29 | 0.56 | 10.4 |  |  |
| GP327/08 | 58.1 | 8.5 | 0.72 | 8.3 | 0.57 | 9.7 | 0.06 | 0.20 | 0.38 | 12.9 |  |  |
| GP327/09 | 59.2 | 9.1 | 0.53 | 9.5 | 0.86 | 9.1 | 0.05 | 0.38 | 0.49 | 10.1 |  |  |
| GP327/11 | 58.5 | 8.2 | 0.44 | 11.5 | 0.65 | 8.5 | 0.05 | 0.23 | 0.41 | 10.7 |  |  |
| GP327/12 | 58.1 | 8.1 | 0.46 | 12.0 | 0.65 | 8.4 | 0.06 | 0.21 | 0.40 | 10.8 |  |  |
| GP327/13 | 59.0 | 8.7 | 0.34 | 10.5 | 0.58 | 8.2 | 0.07 | 0.22 | 0.40 | 11.4 |  |  |
| GP327/14 | 59.5 | 7.0 | 0.36 | 10.0 | 0.55 | 10.2 | 0.09 | 0.25 | 0.36 | 11.0 |  |  |
| GP327/16 | 61.6 | 9.8 | 0.86 | 11.9 | 0.99 | 5.6 | 0.05 | 0.70 | 0.53 | 7.0 |  |  |
| GP327/20 | 57.2 | 10.2 | 0.75 | 10.7 | 1.02 | 6.9 | 0.05 | 0.45 | 0.53 | 11.4 |  |  |
| GM30/03 | 58.4 | 3.2 | 0.16 | 8.7 | 0.14 | 15.5 | 0.10 | 0.01 | 0.15 | 12.9 | 0.64 | 0.49 |
| GM30/06 | 53.2 | 5.6 | 1.57 | 13.2 | 0.29 | 14.8 | 0.26 | 0.22 | 0.19 | 8.8 | 0.42 | 0.44 |
| GM30/09 | 57.3 | 2.5 | 0.15 | 11.3 | 0.06 | 14.4 | 0.03 | 0.02 | 0.11 | 13.3 | 0.69 | 0.49 |
| GM30/10 | 58.4 | 2.9 | 0.15 | 11.5 | 0.09 | 13.9 | 0.02 | 0.02 | 0.13 | 12.1 | 0.69 | 0.44 |
| GM30/11 | 57.7 | 3.7 | 0.18 | 10.7 | 0.15 | 14.4 | 0.03 | 0.02 | 0.18 | 12.1 | 0.63 | 0.45 |
| GM30/13 | 55.5 | 3.6 | 0.18 | 12.8 | 0.14 | 13.8 | 0.12 | 0.02 | 0.15 | 12.7 | 0.65 | 0.41 |
| GM30/17 | 56.9 | 2.8 | 0.22 | 11.2 | 0.09 | 15.8 | 0.08 | 0.02 | 0.12 | 11.9 | 0.66 | 0.63 |
| GM30/18 | 55.5 | 3.9 | 0.31 | 12.4 | 0.16 | 15.7 | 0.23 | 0.02 | 0.16 | 10.6 | 0.59 | 0.62 |
| GM30/19 | 54.7 | 4.0 | 0.39 | 13.2 | 0.15 | 15.9 | 0.16 | 0.02 | 0.12 | 10.2 | 0.65 | 0.48 |
| GM30/20 | 56.6 | 2.2 | 0.24 | 10.5 | 0.05 | 17.3 | 0.03 | 0.01 | 0.09 | 12.0 | 0.73 | 0.70 |
| GM30/21 | 52.7 | 2.1 | 0.44 | 15.0 | 0.05 | 17.9 | 0.06 | 0.02 | 0.08 | 9.9 | 0.67 | 0.56 |
| GM30/23 | 56.1 | 1.7 | 0.31 | 12.3 | 0.02 | 18.2 | 0.19 | 0.01 | 0.07 | 9.9 | 0.67 | 0.65 |
| GM81/02 | 52.0 | 2.9 | 0.48 | 16.5 | 0.14 | 15.2 | 0.33 | 0.02 | 0.13 | 11.0 | 0.74 | 0.23 |
| GM81/04 | 52.1 | 3.0 | 0.47 | 18.2 | 0.09 | 13.4 | 0.35 | 0.02 | 0.14 | 10.5 | 0.75 | 0.24 |
| GM81/06 | 42.9 | 1.7 | 1.60 | 11.2 | 0.07 | 20.3 | 0.21 | 0.02 | 0.08 | 20.8 | 0.75 | 0.38 |
| GM81/07 | 46.4 | 1.8 | 5.24 | 11.9 | 0.07 | 17.4 | 0.21 | 0.02 | 0.08 | 15.8 | 0.78 | 0.38 |
| GM81/14 | 53.2 | 3.3 | 0.32 | 16.7 | 0.13 | 13.4 | 0.31 | 0.02 | 0.16 | 11.1 | 0.74 | 0.13 |
| GM81/15 | 53.2 | 3.1 | 0.31 | 15.1 | 0.13 | 15.6 | 0.26 | 0.02 | 0.15 | 10.8 | 0.72 | 0.25 |
| GM81/21 | 53.4 | 3.0 | 0.46 | 14.8 | 0.12 | 15.9 | 0.29 | 0.02 | 0.13 | 10.4 | 0.72 | 0.39 |
| GM81/23 | 54.0 | 2.5 | 0.48 | 14.3 | 0.16 | 16.8 | 0.19 | 0.01 | 0.09 | 10.2 | 0.69 | 0.53 |
| GM81/29 | 57.9 | 1.1 | 0.45 | 11.4 | 0.01 | 19.0 | 0.20 | 0.01 | 0.03 | 8.6 | 0.67 | 0.71 |
| GM81/31 | 52.4 | 2.6 | 1.24 | 18.0 | 0.03 | 13.9 | 0.11 | 0.01 | 0.09 | 10.1 | 0.60 | 0.21 |
| GM81/34 | 44.5 | 2.7 | 0.97 | 10.2 | 0.10 | 27.5 | 0.07 | 0.01 | 0.11 | 13.4 | 0.46 | 0.78 |
| GM81/35 | 55.3 | 3.4 | 0.29 | 11.7 | 0.10 | 18.1 | 0.08 | 0.01 | 0.16 | 9.7 | 0.57 | 0.57 |
| GM81/39 | 53.2 | 2.2 | 0.42 | 17.2 | 0.02 | 14.2 | 0.36 | 0.01 | 0.07 | 10.4 | 0.64 | 0.44 |
| GM81/42 | 51.5 | 2.7 | 0.49 | 17.4 | 0.04 | 15.3 | 0.21 | 0.01 | 0.09 | 10.5 | 0.58 | 0.48 |
| GL68/02 | 56.6 | 7.4 | 1.00 | 14.4 | 0.52 | 8.7 | 0.05 | 0.20 | 0.35 | 9.2 | 0.42 | 0.15 |
| GL68/03 | 54.5 | 4.7 | 2.92 | 13.2 | 0.49 | 11.4 | 0.12 | 0.20 | 0.22 | 11.1 | 0.57 | 0.29 |
| GL68/06 | 28.6 | 2.6 | 17.0 | 6.3 | 0.18 | 15.4 | 0.14 | 0.03 | 0.10 | 28.9 | 0.49 | 0.70 |
| GL68/07 | 54.8 | 5.8 | 0.74 | 13.7 | 0.51 | 12.7 | 0.05 | 0.12 | 0.22 | 10.1 | 0.47 | 0.60 |
| GL68/10 | 54.9 | 5.0 | 0.49 | 14.4 | 0.38 | 13.3 | 0.09 | 0.04 | 0.24 | 10.3 | 0.56 | 0.39 |
| GL68/12 | 55.8 | 4.5 | 0.64 | 11.0 | 0.19 | 13.8 | 0.16 | 0.01 | 0.22 | 12.8 | 0.58 | 0.31 |
| GL68/15 | 46.6 | 3.4 | 5.24 | 9.3 | 0.14 | 16.2 | 0.11 | 0.01 | 0.17 | 17.9 | 0.56 | 0.45 |
| GL68/17 | 49.9 | 4.4 | 3.89 | 10.3 | 0.18 | 13.8 | 0.18 | 0.02 | 0.22 | 16.4 | 0.56 | 0.26 |
| GL68/20 | 51.9 | 4.8 | 2.26 | 13.8 | 0.15 | 12.4 | 0.21 | 0.02 | 0.24 | 13.2 | 0.58 | 0.27 |
| GL68/28 | 53.1 | 5.0 | 1.31 | 15.3 | 0.42 | 13.0 | 0.14 | 0.11 | 0.23 | 10.3 | 0.49 | 0.46 |

GK = Knidi borehole, GP = Pilori borehole, GM = Harami borehole, GL = Velanida borehole.

Table S3. Physical parameters of samples (*n* = 70).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sample id | ABD | WW | WO% | MBA |
| g/cm3 | % | % | ml |
| GK66/02 | 0.858 | 137.5 | 47.2 | 18.5 |
| GK66/05 | 0.784 | 206.5 | 50.1 | 20.4 |
| GK66/07 | 0.637 | 200.1 | 66.5 | 18.7 |
| GK66/08 | 0.689 | 132.3 | 62.0 | 11.5 |
| GK66/09 | 0.681 | 128.5 | 62.4 | 10.9 |
| GK66/11 | 0.778 | 128.9 | 55.0 | 13.8 |
| GK66/12 | 0.693 | 172.9 | 65.7 | 6.6 |
| GK66/13 | 0.646 | 205.7 | 73.3 | 9.2 |
| GK66/14 | 0.610 | 197.5 | 81.4 | 8.2 |
| GK66/15 | 0.640 | 217.5 | 72.3 | 14.5 |
| GK66/18 | 0.857 | 102.5 | 48.6 | 11.9 |
| GK135/01 | 0.722 | 152.5 | 64.1 | 17.9 |
| GK135/03 | 0.703 | 154.4 | 54.9 | 17.9 |
| GK135/05 | 0.673 | 169.0 | 68.4 | 16.0 |
| GK135/08 | 0.715 | 138.0 | 64.2 | 10.4 |
| GK135/09 | 0.679 | 180.8 | 68.5 | 14.4 |
| GK135/10 | 0.640 | 205.7 | 69.7 | 16.0 |
| GK135/12 | 0.747 | 125.6 | 59.3 | 15.6 |
| GP325/01 | 0.960 | 113.4 | 39.9 | 11.1 |
| GP325/02 | 0.952 | 159.7 | 27.4 | 14.3 |
| GP325/03 | 0.781 | 154.0 | 41.8 | 13.6 |
| GP325/04 | 0.705 | 135.7 | 63.7 | 7.0 |
| GP327/01 | 0.781 | 106.4 | 49.7 | 4.9 |
| GP327/03 | 0.824 | 127.5 | 56.0 | 5.6 |
| GP327/05 | 0.819 | 140.1 | 40.8 | 7.4 |
| GP327/06 | 0.807 | 144.5 | 49.4 | 9.0 |
| GP327/08 | 0.621 | 109.6 | 60.5 | 4.7 |
| GP327/09 | 0.665 | 104.5 | 56.6 | 8.4 |
| GP327/11 | 0.711 | 121.1 | 51.9 | 9.5 |
| GP327/12 | 0.709 | 144.9 | 59.9 | 10.4 |
| GP327/13 | 0.651 | 105.3 | 64.9 | 6.1 |
| GP327/14 | 0.609 | 109.9 | 72.6 | 8.8 |
| GP327/16 | 1.002 | 146.9 | 30.5 | 15.5 |
| GP327/20 | 0.844 | 149.4 | 40.6 | 11.3 |
| GM30/03 | 0.546 | 146.8 | 96.4 | 7.0 |
| GM30/06 | 0.788 | 127.2 | 53.8 | 18.7 |
| GM30/09 | 0.448 | 181.4 | 114.4 | 13.4 |
| GM30/10 | 0.411 | 212.1 | 134.3 | 16.1 |
| GM30/11 | 0.397 | 234.8 | 140.4 | 16.2 |
| GM30/13 | 0.549 | 181.1 | 89.7 | 18.4 |
| GM30/17 | 0.608 | 176.1 | 91.0 | 19.2 |
| GM30/18 | 0.742 | 190.0 | 54.1 | 25.2 |
| GM30/19 | 0.719 | 223.6 | 62.2 | 27.4 |
| GM30/20 | 0.568 | 209.8 | 93.6 | 17.8 |
| GM30/21 | 0.806 | 167.8 | 54.0 | 23.0 |
| GM30/23 | 0.711 | 214.0 | 66.5 | 26.9 |
| GM81/02 | 0.747 | 195.9 | 54.7 | 22.2 |
| GM81/04 | 0.784 | 217.0 | 50.9 | 23.4 |
| GM81/06 | 0.725 | 158.7 | 66.9 | 19.2 |
| GM81/07 | 0.765 | 205.1 | 58.8 | 23.4 |
| GM81/14 | 0.765 | 202.0 | 56.8 | 22.1 |
| GM81/15 | 0.756 | 202.0 | 60.2 | 22.1 |
| GM81/21 | 0.799 | 169.2 | 56.0 | 23.2 |
| GM81/23 | 0.766 | 159.5 | 62.2 | 24.3 |
| GM81/29 | 0.799 | 145.1 | 48.5 | 20.8 |
| GM81/31 | 0.911 | 186.1 | 37.8 | 29.4 |
| GM81/34 | 0.759 | 152.0 | 65.8 | 13.5 |
| GM81/35 | 0.788 | 193.6 | 50.3 | 24.7 |
| GM81/39 | 0.829 | 194.3 | 47.9 | 27.9 |
| GM81/42 | 0.856 | 186.4 | 55.3 | 27.7 |
| GL68/02 | 0.860 | 206.4 | 28.6 | 26.9 |
| GL68/03 | 0.774 | 145.5 | 53.8 | 17.0 |
| GL68/06 | 0.711 | 168.2 | 58.8 | 14.6 |
| GL68/07 | 0.670 | 212.5 | 61.1 | 22.7 |
| GL68/10 | 0.721 | 199.6 | 58.5 | 21.3 |
| GL68/12 | 0.627 | 184.5 | 84.6 | 11.1 |
| GL68/15 | 0.597 | 206.7 | 90.2 | 11.1 |
| GL68/17 | 0.636 | 170.9 | 82.0 | 10.9 |
| GL68/20 | 0.687 | 206.6 | 70.0 | 19.3 |
| GL68/28 | 0.870 | 223.3 | 41.8 | 26.9 |

GK = Knidi borehole, GP = Pilori borehole, GM = Harami borehole, GL = Velanida borehole.

Table S4. Bleaching performance parameters of samples (n = 70). GK = Knidi borehole, GP = Pilori borehole, GM = Harami borehole, GL = Velanida borehole.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sample id | Vis | Red | Yellow | Chl |
| % |  |  | ppm |
| GK66/02 | 5.3 | 4.3 | 70.0 | 0.816 |
| GK66/05 | 12.1 | 4.0 | 70.0 | 0.419 |
| GK66/07 | 27.3 | 2.6 | 51.0 | 0.124 |
| GK66/08 | 17.7 | 3.0 | 70.0 | 0.376 |
| GK66/09 | 22.3 | 3.0 | 63.0 | 0.224 |
| GK66/11 | 16.5 | 3.5 | 70.0 | 0.293 |
| GK66/12 | 18.9 | 3.1 | 70.0 | 0.369 |
| GK66/13 | 25.2 | 2.9 | 57.0 | 0.198 |
| GK66/14 | 22.0 | 2.6 | 70.0 | 0.261 |
| GK66/15 | 20.6 | 3.1 | 70.0 | 0.332 |
| GK66/18 | 7.8 | 4.1 | 70.0 | 0.733 |
| GK135/01 | 16.4 | 3.3 | 70.0 | 0.442 |
| GK135/03 | 21.7 | 3.0 | 70.0 | 0.257 |
| GK135/05 | 26.7 | 2.5 | 57.0 | 0.124 |
| GK135/08 | 22.3 | 3.0 | 63.0 | 0.252 |
| GK135/09 | 27.7 | 2.3 | 57.0 | 0.137 |
| GK135/10 | 29.0 | 2.5 | 51.0 | 0.116 |
| GK135/12 | 24.5 | 2.5 | 57.0 | 0.238 |
| GP325/01 | 2.6 | 5.2 | 70.0 | 0.784 |
| GP325/02 | 2.9 | 4.8 | 70.0 | 0.885 |
| GP325/03 | 20.8 | 3.2 | 70.0 | 0.237 |
| GP325/04 | 22.3 | 2.9 | 69.0 | 0.187 |
| GP327/01 | 10.7 | 3.8 | 70.0 | 0.485 |
| GP327/03 | 5.5 | 4.8 | 70.0 | 0.451 |
| GP327/05 | 19.5 | 3.1 | 70.0 | 0.232 |
| GP327/06 | 16.1 | 3.3 | 70.0 | 0.360 |
| GP327/08 | 18.6 | 2.9 | 70.0 | 0.251 |
| GP327/09 | 22.5 | 2.4 | 57.0 | 0.160 |
| GP327/11 | 23.0 | 2.5 | 57.0 | 0.187 |
| GP327/12 | 18.9 | 3.1 | 70.0 | 0.292 |
| GP327/13 | 19.4 | 2.9 | 69.0 | 0.243 |
| GP327/14 | 21.8 | 2.4 | 57.0 | 0.196 |
| GP327/16 | 0.5 | 6.5 | 70.9 | 1.801 |
| GP327/20 | 7.9 | 3.8 | 70.0 | 0.770 |
| GM30/03 | 10.4 | 4.2 | 70.0 | 0.412 |
| GM30/06 | 0.3 | 7.2 | 72.0 | 2.520 |
| GM30/09 | 36.1 | 1.3 | 16.0 | 0.011 |
| GM30/10 | 38.8 | 1.2 | 15.0 | 0.003 |
| GM30/11 | 39.3 | 2.0 | 35.0 | 0.028 |
| GM30/13 | 29.2 | 2.4 | 51.0 | 0.141 |
| GM30/17 | 29.2 | 2.0 | 51.0 | 0.138 |
| GM30/18 | 6.3 | 4.5 | 70.0 | 0.570 |
| GM30/19 | 1.0 | 6.0 | 70.0 | 1.232 |
| GM30/20 | 29.0 | 2.1 | 46.0 | 0.126 |
| GM30/21 | 1.2 | 5.5 | 70.0 | 1.335 |
| GM30/23 | 19.1 | 3.2 | 70.0 | 0.209 |
| GM81/02 | 16.2 | 3.6 | 70.0 | 0.395 |
| GM81/04 | 15.3 | 3.8 | 70.0 | 0.432 |
| GM81/06 | 11.1 | 4.0 | 70.0 | 0.384 |
| GM81/07 | 10.7 | 4.3 | 70.0 | 0.485 |
| GM81/14 | 19.9 | 3.2 | 70.0 | 0.260 |
| GM81/15 | 14.2 | 3.8 | 70.0 | 0.372 |
| GM81/21 | 9.9 | 4.1 | 70.0 | 0.461 |
| GM81/23 | 2.8 | 4.8 | 70.0 | 0.838 |
| GM81/29 | 4.4 | 4.8 | 70.0 | 0.726 |
| GM81/31 | 1.3 | 5.5 | 70.0 | 1.401 |
| GM81/34 | 10.9 | 4.3 | 70.0 | 0.186 |
| GM81/35 | 5.1 | 4.6 | 70.0 | 0.568 |
| GM81/39 | 6.6 | 4.2 | 70.0 | 0.726 |
| GM81/42 | 14.1 | 3.8 | 70.0 | 0.378 |
| GL68/02 | 1.6 | 5.5 | 70.0 | 1.198 |
| GL68/03 | 8.2 | 4.1 | 70.0 | 0.634 |
| GL68/06 | 4.8 | 4.5 | 70.0 | 0.690 |
| GL68/07 | 5.5 | 4.3 | 70.0 | 0.725 |
| GL68/10 | 10.8 | 3.9 | 70.0 | 0.543 |
| GL68/12 | 24.2 | 2.4 | 57.0 | 0.220 |
| GL68/15 | 21.3 | 2.8 | 70.0 | 0.271 |
| GL68/17 | 22.2 | 2.6 | 69.0 | 0.253 |
| GL68/20 | 15.9 | 3.2 | 70.0 | 0.371 |
| GL68/28 | 0.7 | 6.2 | 70.5 | 1.671 |

Table S5. Correlation matrix (Spearman correlation) for palygorskite-smectite from all four studied deposits (*n* = 25).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ABD | WO | MBA | Red | Yellow | Chl | Vis | Sme | Plg | Srp | Qz | Cal | Dol | NIRx | NIRy | SiO2 | Al2O3 | Fe2O3 | MgO | CaO |
| ABD | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WO | –.910\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MBA | –0.188 | 0.185 | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Red | .786\*\* | –.773\*\* | 0.148 | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Yellow | .834\*\* | –.790\*\* | 0.160 | .900\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Chl | .771\*\* | –.730\*\* | 0.155 | .918\*\* | .886\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Vis | –.801\*\* | .769\*\* | –0.131 | –.975\*\* | –.916\*\* | –.948\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sme | –0.293 | 0.345 | .910\*\* | 0.037 | 0.033 | 0.106 | –0.044 | – |  |  |  |  |  |  |  |  |  |  |  |  |
| Plg | –.552\*\* | .584\*\* | –0.006 | –.703\*\* | –.589\*\* | –.778\*\* | .716\*\* | –0.091 | – |  |  |  |  |  |  |  |  |  |  |  |
| Srp | 0.215 | –0.243 | –.465\* | 0.019 | 0.073 | 0.052 | –0.026 | –.474\* | –0.305 | – |  |  |  |  |  |  |  |  |  |  |
| Qz | .425\* | –.619\*\* | –.438\* | 0.357 | 0.288 | 0.321 | –0.348 | –.577\*\* | –0.221 | 0.141 | – |  |  |  |  |  |  |  |  |  |
| Cal | .456\* | –.436\* | –0.385 | .405\* | 0.348 | 0.395 | –0.370 | –.399\* | –0.245 | 0.070 | 0.367 | – |  |  |  |  |  |  |  |  |
| Dol | 0.143 | –0.010 | 0.144 | .408\* | 0.378 | .459\* | –.466\* | 0.178 | –0.263 | –0.209 | –0.042 | 0.222 | – |  |  |  |  |  |  |  |
| NIRx | –0.344 | .537\*\* | 0.346 | –0.257 | –0.300 | –0.118 | 0.196 | .614\*\* | –0.116 | –0.289 | –.800\*\* | –0.241 | 0.082 | – |  |  |  |  |  |  |
| NIRy | –.751\*\* | .561\*\* | 0.188 | –.459\* | –.602\*\* | –0.345 | .441\* | 0.298 | 0.119 | –0.281 | –0.048 | –0.279 | –0.024 | 0.299 | – |  |  |  |  |  |
| SiO2 | –0.371 | 0.256 | –0.194 | –.460\* | –.410\* | –.464\* | .483\* | –0.201 | .508\*\* | –0.150 | 0.359 | –0.170 | –.443\* | –0.280 | 0.274 | – |  |  |  |  |
| Al2O3 | .497\* | –.634\*\* | –.415\* | 0.362 | .406\* | 0.260 | –0.352 | –.649\*\* | 0.025 | 0.187 | .795\*\* | 0.254 | 0.032 | –.958\*\* | –.419\* | 0.194 | – |  |  |  |
| Fe2O3 | –0.062 | 0.159 | .524\*\* | 0.046 | 0.103 | 0.145 | –0.089 | .594\*\* | –0.214 | –0.087 | –.473\* | –0.171 | 0.074 | .554\*\* | –0.123 | –.408\* | –.525\*\* | – |  |  |
| MgO | –.470\* | .562\*\* | 0.109 | –.459\* | –.516\*\* | –.413\* | .469\* | 0.308 | 0.029 | 0.193 | –.682\*\* | –0.309 | –0.117 | .574\*\* | 0.389 | –0.234 | –.746\*\* | 0.182 | – |  |
| CaO | .739\*\* | –.702\*\* | 0.016 | .854\*\* | .858\*\* | .805\*\* | –.891\*\* | –0.098 | –.535\*\* | 0.076 | 0.347 | 0.340 | .455\* | –0.345 | –.461\* | –.498\* | .452\* | –0.055 | –.526\*\* | – |

\*\*. Correlation is significant at the 0.01 level (2-tailed).

\*. Correlation is significant at the 0.05 level (2-tailed).

*n* = 23 for NIR data.

Table S6. Correlation matrix (Spearman correlation) for palygorskite from all four studied deposits (*n* = 21).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ABD | WO | MBA | Red | Yellow | Chl | Vis | Sme | Plg | Srp | Qz | Cal | Dol | NIRx | NIRy | SiO2 | Al2O3 | Fe2O3 | MgO | CaO |
| ABD | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WO | –.890\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MBA | –0.322 | 0.411 | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Red | .539\* | –.433\* | –0.422 | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Yellow | 0.283 | –0.299 | –0.294 | .787\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Chl | 0.262 | –0.164 | –0.238 | .826\*\* | .841\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Vis | –0.364 | 0.409 | .500\* | –.851\*\* | –.822\*\* | –.866\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sme | –0.113 | 0.219 | .886\*\* | –0.252 | –0.217 | –0.189 | 0.367 | – |  |  |  |  |  |  |  |  |  |  |  |  |
| Plg | –.509\* | 0.359 | –0.131 | –0.411 | –0.325 | –0.429 | 0.257 | –0.242 | – |  |  |  |  |  |  |  |  |  |  |  |
| Srp | 0.152 | 0.004 | 0.323 | 0.192 | 0.272 | 0.350 | –0.047 | 0.203 | –.686\*\* | – |  |  |  |  |  |  |  |  |  |  |
| Qz | .632\*\* | –.774\*\* | –0.328 | 0.233 | 0.033 | –0.146 | –0.208 | –0.172 | –0.157 | –0.103 | – |  |  |  |  |  |  |  |  |  |
| Cal | –0.320 | 0.140 | 0.040 | –0.394 | –0.112 | –0.240 | 0.200 | 0.060 | 0.301 | –0.051 | –0.201 | – |  |  |  |  |  |  |  |  |
| Dol | 0.333 | –0.247 | –0.198 | 0.237 | 0.173 | 0.286 | –0.248 | 0.083 | –0.320 | –0.094 | 0.033 | 0.131 | – |  |  |  |  |  |  |  |
| NIRx | –.615\* | .752\*\* | –0.106 | –0.171 | –0.297 | –0.018 | 0.128 | –0.009 | 0.193 | –0.129 | –.609\* | 0.150 | –0.263 | – |  |  |  |  |  |  |
| NIRy | –.680\* | .712\* | 0.190 | 0.124 | 0.023 | 0.169 | –0.087 | 0.288 | –0.018 | –0.096 | –0.322 | 0.150 | –0.195 | .751\*\* | – |  |  |  |  |  |
| SiO2 | –0.121 | –0.141 | –0.074 | –0.309 | –0.367 | –.526\* | 0.158 | –0.151 | .585\*\* | –.443\* | .508\* | 0.080 | –.467\* | 0.073 | 0.078 | – |  |  |  |  |
| Al2O3 | .689\*\* | –.824\*\* | –0.421 | 0.220 | 0.076 | –0.132 | –0.218 | –0.204 | –0.029 | –0.217 | .887\*\* | –0.030 | 0.240 | –.890\*\* | –.799\*\* | 0.394 | – |  |  |  |
| Fe2O3 | 0.078 | 0.070 | .568\*\* | –0.271 | –0.277 | –0.292 | 0.430 | 0.380 | –0.133 | 0.283 | –0.033 | –0.271 | –.604\*\* | 0.229 | 0.100 | 0.131 | –0.232 | – |  |  |
| MgO | –.556\*\* | .678\*\* | 0.314 | –0.064 | 0.076 | 0.259 | 0.123 | 0.081 | –0.246 | .529\* | –.724\*\* | 0.040 | –0.184 | 0.147 | 0.428 | –.540\* | –.854\*\* | 0.086 | – |  |
| CaO | .444\* | –.487\* | –0.141 | 0.233 | 0.286 | 0.265 | –0.284 | 0.119 | –0.195 | –0.073 | 0.162 | 0.381 | .712\*\* | –0.422 | –0.311 | –0.326 | 0.378 | –0.400 | –0.332 | – |

\*\*. Correlation is significant at the 0.01 level (2–tailed).

\*. Correlation is significant at the 0.05 level (2–tailed).

n = 11 for NIR data

Table S7. Correlation matrix (Spearman correlation) for smectite from all four studied deposits (n = 24).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ABD | WO | MBA | Red | Yellow | Chl | Vis | Sme | Plg | Srp | Qz | Cal | Dol | NIRx | NIRy | SiO2 | Al2O3 | Fe2O3 | MgO | CaO |
| ABD | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WO | –.866\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MBA | –0.009 | 0.022 | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Red | 0.399 | –.415\* | 0.011 | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Yellow | 0.331 | –0.307 | –0.136 | .577\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Chl | .552\*\* | –.582\*\* | 0.007 | .884\*\* | .575\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Vis | –.448\* | .462\* | –0.015 | –.973\*\* | –.575\*\* | –.949\*\* | – |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sme | –0.047 | 0.069 | .919\*\* | –0.002 | –0.148 | –0.056 | 0.005 | – |  |  |  |  |  |  |  |  |  |  |  |  |
| Plg | –0.268 | 0.186 | –0.353 | –.410\* | –0.277 | –0.370 | .423\* | –.424\* | – |  |  |  |  |  |  |  |  |  |  |  |
| Srp | 0.175 | 0.003 | –0.363 | 0.038 | 0.194 | 0.117 | –0.033 | –0.375 | 0.048 | – |  |  |  |  |  |  |  |  |  |  |
| Qz | .517\*\* | –.672\*\* | –0.397 | .541\*\* | .425\* | .695\*\* | –.623\*\* | –.416\* | –0.079 | –0.064 | – |  |  |  |  |  |  |  |  |  |
| Cal | –0.086 | –0.036 | 0.007 | 0.192 | 0.191 | 0.075 | –0.204 | –0.015 | –0.286 | –0.217 | 0.130 | – |  |  |  |  |  |  |  |  |
| Dol | –0.045 | 0.004 | –0.310 | 0.146 | 0.043 | –0.083 | –0.077 | –0.294 | –0.128 | –0.167 | 0.094 | .735\*\* | – |  |  |  |  |  |  |  |
| NIRx | –0.361 | 0.409 | 0.314 | –0.360 | –0.329 | –0.364 | 0.367 | 0.315 | 0.365 | 0.011 | –.683\*\* | –0.265 | –.491\* | – |  |  |  |  |  |  |
| NIRy | –.502\* | .527\*\* | –0.093 | 0.006 | –0.036 | –0.246 | 0.048 | 0.152 | –0.280 | –0.022 | –0.356 | 0.302 | 0.291 | 0.103 | – |  |  |  |  |  |
| SiO2 | 0.227 | –0.372 | 0.082 | 0.291 | 0.148 | 0.305 | –0.311 | 0.250 | 0.053 | –0.386 | .461\* | –0.192 | –0.241 | –0.188 | –0.105 | – |  |  |  |  |
| Al2O3 | 0.331 | –.439\* | –0.169 | 0.360 | .438\* | 0.378 | –0.365 | –0.282 | 0.140 | –0.137 | .610\*\* | 0.069 | 0.165 | –.637\*\* | –.527\*\* | 0.392 | – |  |  |  |
| Fe2O3 | 0.228 | –0.157 | .584\*\* | –0.169 | –0.001 | 0.065 | 0.085 | 0.394 | –0.114 | 0.165 | –0.206 | –0.244 | –.510\* | 0.324 | –.472\* | –0.220 | –0.009 | – |  |  |
| MgO | –.498\* | .623\*\* | –0.084 | –0.250 | –0.383 | –.430\* | 0.309 | 0.120 | –0.125 | 0.227 | –.620\*\* | 0.010 | 0.069 | 0.405 | .786\*\* | –0.304 | –.739\*\* | –0.333 | – |  |
| CaO | 0.172 | –0.114 | –0.163 | 0.322 | 0.356 | 0.217 | –0.259 | –0.325 | –0.061 | –0.011 | 0.265 | 0.166 | 0.327 | –0.238 | –0.311 | –0.305 | 0.221 | –0.056 | –.426\* | – |

\*\*. Correlation is significant at the 0.01 level (2-tailed).

\*. Correlation is significant at the 0.05 level (2-tailed).

*n* = 23 for NIR data



Fig. S1. XRD pattern of GK66/2 (Knidi smectite).



Fig. S2. XRD pattern of GK135/3 (Knidi palygorskite-smectite).



Fig. S3. XRD pattern of GK66/13 (Knidi palygorskite).



Fig. S4. XRD pattern of GP325/2 (Pilori smectite).



Fig. S5. XRD pattern of GP325/3 (Pilori palygorskite-smectite).



Fig. S6. XRD pattern of GP325/4 (Pilori palygorskite).



Fig S7. XRD pattern of GM30/23 (Harami smectite).



Fig. S8. XRD pattern of GM30/17 (Harami palygorskite-smectite).



Fig S9. XRD pattern of GM30/3 (Harami palygorskite).



Fig. S10. XRD pattern of GL68/2 (Velanida smectite).



Fig. S11. XRD pattern of GL68/20 (Velanida palygorskite-smectite).

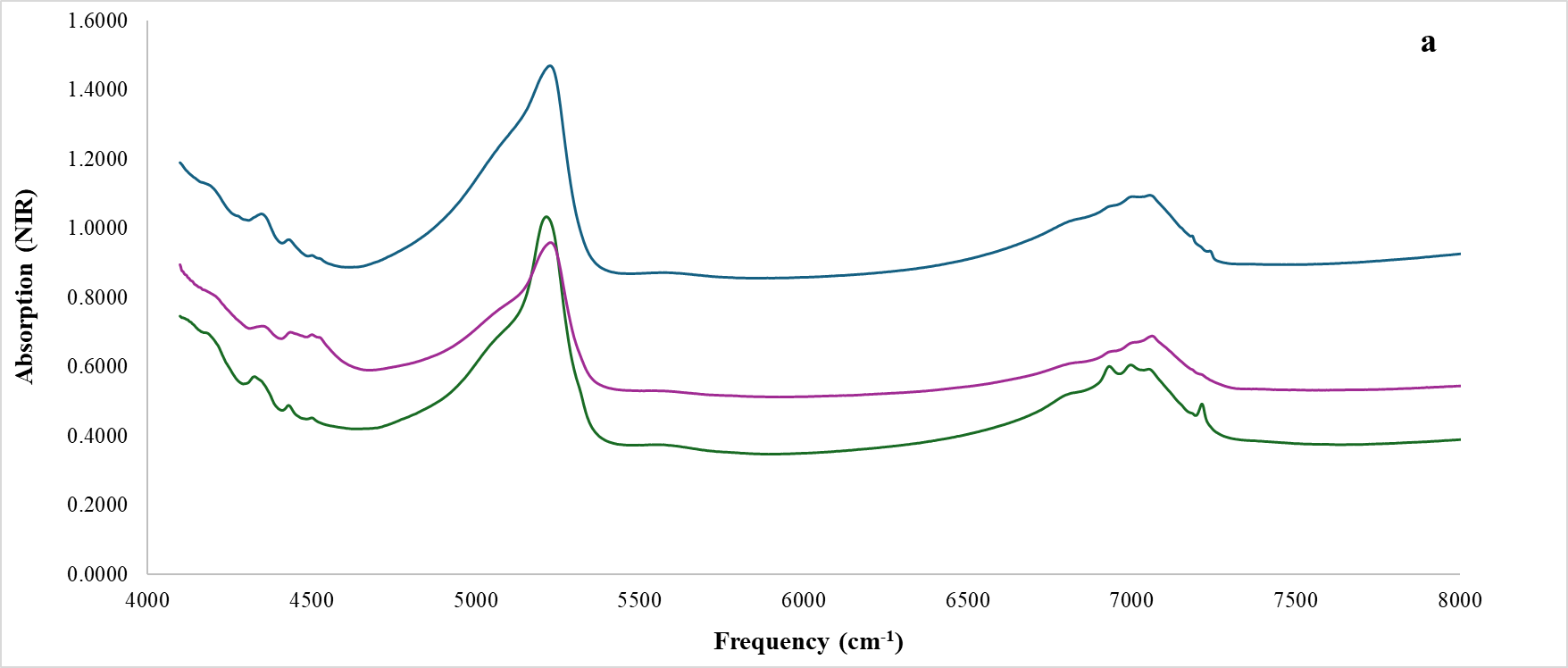


Fig. S12. XRD pattern of GL68/12 (Velanida palygorskite).

|  |
| --- |
| Legend (for Figs S1–S12): |
| Sme = smectite, Plg = palygorskite, Srp = serpentine, Qz = quartz, En = enstatite, Fsp = feldspar, Dol = dolomite, Sep = sepiolite, Cal = calcite, Tlc = talc, Tr = tremolite. Mineral abbreviations adapted from Warr (2021). |



Fig. S13**.** XRD pattern of hand-picked opal separated from palygorskite located at the center of the Harami deposit. Plg = palygorskite, Opl = opal-A’, Qz = quartz, Clc = clinochlore, Tlc = talc, Brt = baryte. Mineral abbreviations adapted from Warr (2021).



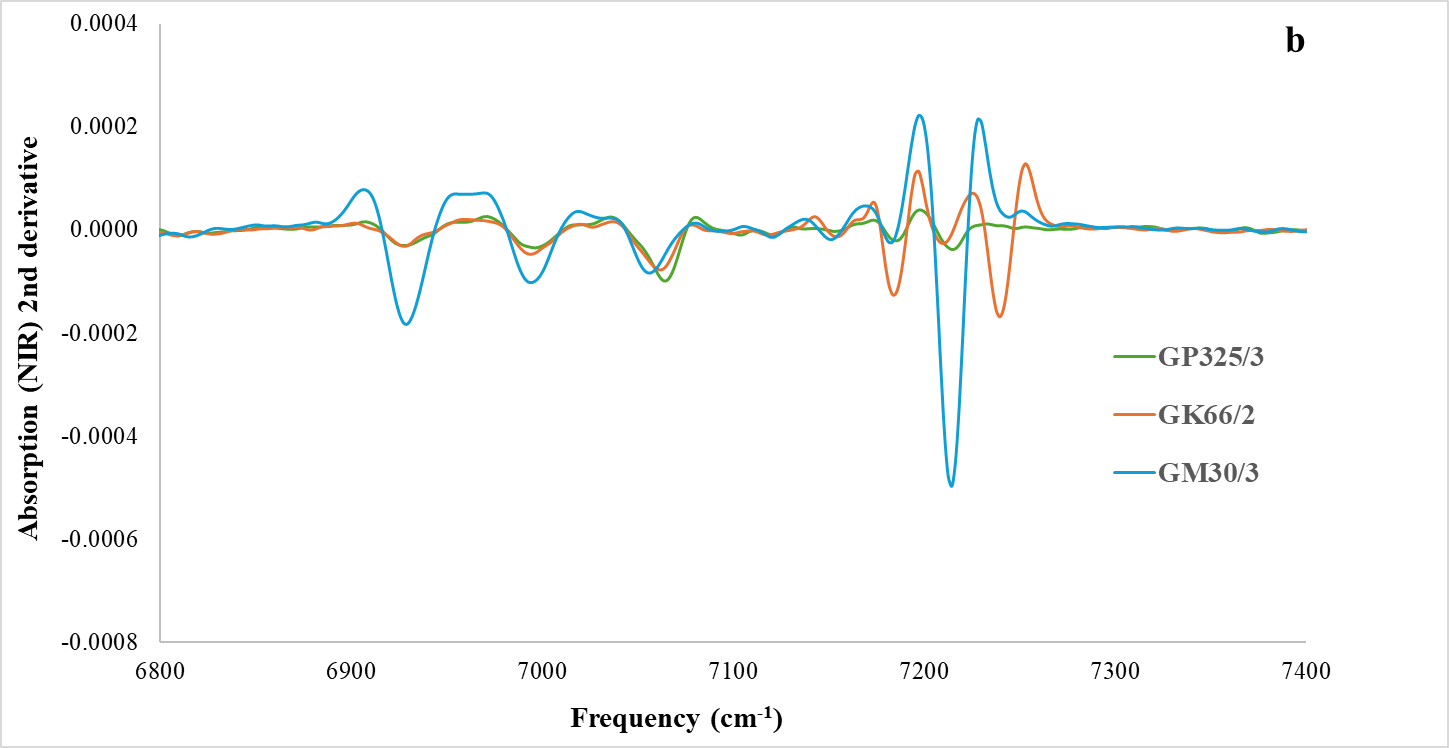


Fig. S14. (a) NIR absorption spectra of three characteristic samples (GK66/2 from the Knidi deposit, GP325/3 from the Pilori deposit and GM30/3 from the Harami deposit). (b) NIR absorption spectra (2nd derivative, 13 pt smoothing) of the three characteristic samples from Fig. S14a. The 2v(OH) assignments of the diagnostic NIR bands (cm–1) used for palygorskite were: Fe3+Fe3+OH = 6928, AlFe3+OH = 6994, AlAlOH = 7056, Mg3OH = 7214 (Gionis et al., 2007).

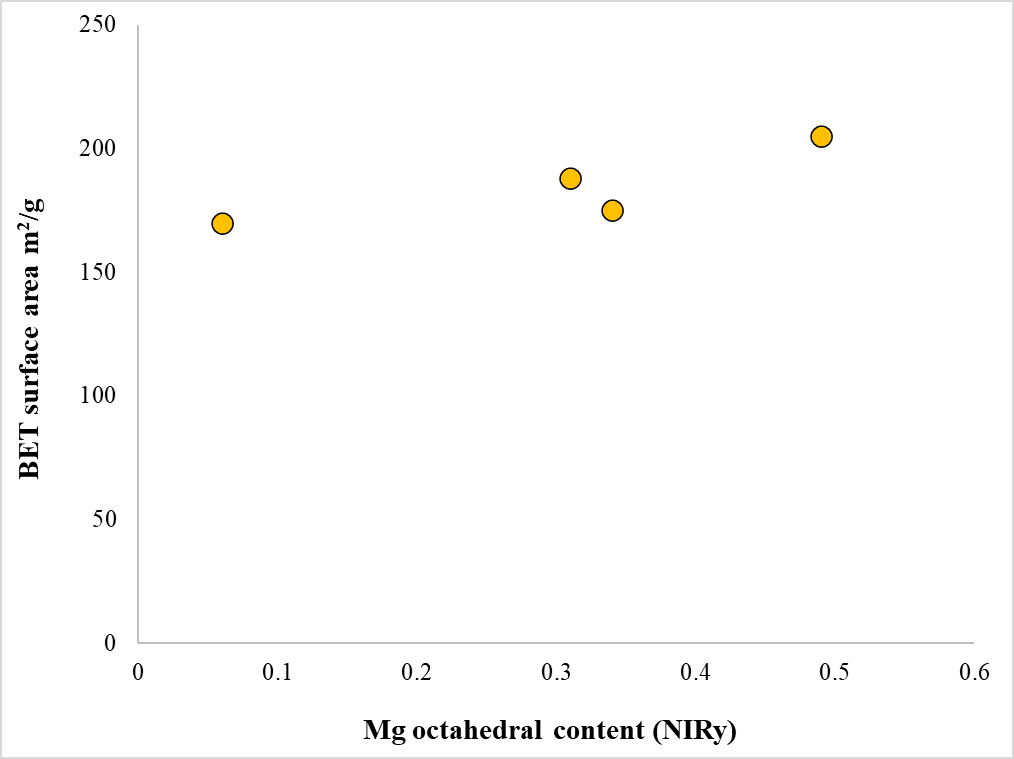


Fig. S15. A binary plot shows a high correlation between Mg in octahedral positions and BET surface area in palygorskite-rich samples.

A diagram of a triangle with red and green dots

Description automatically generated

Fig. S16. Ternary diagram of palygorskite rich clay samples (n=63) with > 20 % Pal: a) MgO-Fe2O3-Al2O3 bulk content of samples classified according to their bleaching performance (Vis), and b) Mg5, Mg2Fe2 and Mg2Al2 octahedral composition of samples grouped according to their bleaching performance.