**Supplementary Data File B: δ13Corg and C:N ratios for organic carbon in the Lower Pliocene Kueichulin Fm, Da’an River, Taiwan**

*Analytical Methods*

The 154 samples taken for carbon and nitrogen analysis were cleaned used deionized water and then dried in an oven at 60°C for 48 h. Clean and dried samples were pulverized and sieved through a very fine (0.63 mm) mesh. One gram of each sample was extracted from the base pan after sieving and put into a plastic vial. The weight of this sample was recorded (Sample Weightpre-acid). 5 mL of 2 N hydrochloric acid (HCl) was then added to the vials to remove inorganic carbon, and samples were left for approximately 16 hours at room temperature. Random samples were re-tested with more HCl to determine if the initial amount was sufficient to remove all carbonate material. The samples were then washed with 5 mL deionized water and centrifuged at 5000 rpm for 5 minutes to remove HCl from the sample; this was repeated 8 times. Whatman® paper universal was used as pH indicator to determine if additional flushing was needed. The de-carbonated samples were dried at 50°C for 72 hours, re-pulverized, and weighed (Sample Weightpost-acid).

A 25 mg sub-sample was extracted from each de-carbonated sample and was placed in a tin capsule in preparation for measuring total organic carbon and nitrogen contents. The elemental analyses were done using an Elemental Analyzer (Elementar vario MICRO cube) in Pei-Ling Wang’s Marine Geochemistry lab in the Institute of Oceanography, National Taiwan University, Taiwan. The standard used in elemental analysis is soil standard no.502-062 Leco Reference Materials (%C = 0.924, %N = 0.093). All measurements were performed in duplicate and the relative error by multiple analyses of reference material was less than 2 %. The real value of TOC (TOCSediment) was calibrated using the formula:

$$TOC\_{Sediment}=TOC\_{Measured}∙\left(\frac{Weight\_{Pre-acid}}{Weight\_{Post-acid}}\right)∙StdDev$$

The stable carbon isotope composition was measured using an elemental analyzer (Thermo Flash EA) connected with an isotope ratio mass spectrometry (Thermo Finnigan Delta V). All isotope values, δ13C, are presented in standard δ-notation in per mil (‰) with respect to Vienna Pee Dee Belemnite (VPDB). The measurements were calibrated with the standard reference material IAEA-CH-3 (δ13C = –24.72 ± 0.05 ‰) and the analytical reproducibility for both δ13C is better than 0.2‰.

*Summary of all data:*

|  |  |  |  |
| --- | --- | --- | --- |
| **Stratal Interval / Sample type** | **n** | **δ13Corg (‰)** | **C:N** |
| *Shihliufen Shale* |
| Dark gray mudstone (0–34 m) | 30 |  -24.2 ± 0.4 | 5.3 ± 0.4 |
| *Yutengping Sandstone* |  |  |  |
| Highly bioturbated sandy mudstone and muddy sandstone (34–73 m) | 20 |  -25.7 ± 0.4 | 8.1 ± 1.9 |
| Transitional strata (73–96 m) | 18 |  -26.0 ± 0.6 | 7.9 ± 1.6 |
| Low-BI heterolithic strata (96–201.5 m) | 75 |  -26.7 ± 0.4 | 8.6 ± 1.5 |
| Tropical cyclone (TC) beds (~171–174 m) | 5 |  -26.7 ± 0.4 | 10.3 ± 2.8 |
| *Terrestrial Organic Fossil Plant Material* |
| Coal | 3 |  -26.0 ± 0.5 | 55.2 ± 7.9 |
| Organic laminae (organic detritus) | 3 |  -27.4 ± 0.3 | 37.4 ± 9.1 |

*Values:*

Data are colour codes by interval or bed type:

Pink = dark gray mudstone (Shihliufen Shale)

Green = high-BI sandy mudstone to muddy sandstone

Yellow: transition zone

Blue: low-BI heterolithics

Orange: tropical cyclone (TC) beds

Gray: coal clasts (CC) and organic lamina (OL)

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| --- | --- | --- | --- |
| **Sample Name** | **Outcrop Position (m)** | **δ13Corg (‰ vs. VPDB)** | **C:N ratio (n/n)** |
| DRY 19 - 0.1 m | 0.1 | -24.9 | 5.0 |
| DRY 19 - 1 m | 1 | -24.7 | 5.2 |
| DRY 19 - 2 m | 2 | -24.4 | 5.6 |
| DRY 19 - 3 m | 3 | -24.6 | 4.8 |
| DRY 19 - 4 m | 4 | -24.5 | 5.6 |
| DRY 19 - 5 m | 5 | -24.2 | 5.9 |
| DRY 19 - 6 m | 6 | -25.0 | 6.2 |
| DRY 19 - 7 m | 7 | -23.7 | 6.0 |
| DRY 19 - 8 m | 8 | -24.6 | 6.0 |
| DRY 19 - 9 m | 9 | -23.7 | 4.9 |
| DRY 19 - 10 m | 10 | -23.6 | 5.4 |
| DRY 19 - 11 m | 11 | -23.5 | 4.3 |
| DRY 19 - 12 m | 12 | -23.7 | 4.8 |
| DRY 19 - 13 m | 13 | -24.0 | 5.2 |
| DRY 19 - 14 m | 14 | -23.9 | 5.1 |
| DRY 19 - 15 m | 15 | -24.2 | 5.2 |
| DRY 19 - 16 m | 16 | -24.0 | 5.2 |
| DRY 19 - 17 m | 17 | -24.2 | 5.9 |
| DRY 19 - 18 m | 18 | -24.2 | 5.0 |
| DRY 19 - 19 m | 19 | -24.5 | 5.5 |
| DRY 19 - 21 m | 21 | -24.2 | 5.3 |
| DRY 19 - 22 m | 22 | -23.8 | 5.0 |
| DRY 19 - 23 m | 23 | -24.5 | 5.3 |
| DRY 19 - 24 m | 24 | -24.4 | 5.1 |
| DRY 19 - 25 m | 25 | -24.2 | 5.7 |
| DRY 19 - 26 m | 26 | -23.6 | 5.3 |
| DRY 19 - 27 m | 27 | -24.3 | 5.2 |
| DRY 19 - 28 m | 28 | -24.0 | 5.2 |
| DRY 19 - 29 m | 29 | -24.0 | 4.5 |
| DRY 19 - 30 m | 30 | -24.6 | 5.3 |
| DRY 19 - 34 m | 34 | -25.6 | 6.5 |
| DRY 19 - 35 m | 35 | -25.6 | 6.9 |
| DRY 19 - 36 m | 36 | -25.3 | 6.8 |
| DRY 19 - 37 m | 37 | -25.1 | 6.3 |
| **Sample Name** | **Outcrop Position (m)** | **δ13Corg (‰ vs. VPDB)** | **C:N ratio (n/n)** |
| DRY 19 - 38 m | 38 | -25.2 | 7.6 |
| DRY 19 - 39 m | 39 | -26.1 | 9.2 |
| DRY 19 - 40 m | 40 | -26.5 | 15.0 |
| DRY 19 - 41 m CC | 41 | -25.9 | 55.0 |
| DRY 19 - 45.25 m | 45.25 | -26.2 | 9.3 |
| DRY 19 - 55 m | 55 | -25.9 | 9.9 |
| DRY 19 - 56 m | 56 | -25.4 | 7.2 |
| DRY 19 - 57 m | 57 | -26.0 | 8.9 |
| DRY 19 - 58 m | 58 | -26.0 | 7.8 |
| DRY 19 - 59 m | 59 | -25.7 | 8.0 |
| DRY 19 - 60 m | 60 | -26.3 | 9.4 |
| DRY 19 - 60.9 m | 60.9 | -26.0 | 8.4 |
| DRY 19 - 62 m | 62 | -25.5 | 7.4 |
| DRY 19 - 63 m | 63 | -26.3 | 7.8 |
| DRY 19 - 64.3 m | 64.3 | -25.6 | 7.2 |
| DRY 19 - 72 m | 72 | -24.7 | 6.1 |
| DRY 19 - 73 m | 73 | -25.6 | 6.9 |
| DRY 19 - 74.24 m | 74.24 | -26.0 | 6.1 |
| DRY 19 - 75.27 m | 75.27 | -25.0 | 4.7 |
| DRY 19 - 77.15 m | 77.15 | -25.6 | 7.7 |
| DRY 19 - 78 m | 78 | -25.7 | 7.9 |
| DRY 19 - 79 m | 79 | -25.7 | 7.3 |
| DRY 19 - 81.68 m | 81.68 | -26.3 | 11.6 |
| DRY 19 - 83.35 m | 83.35 | -25.1 | 6.0 |
| DRY 19 - 84.1 m | 84.1 | -26.6 | 6.8 |
| DRY 19 - 85 m | 85 | -26.3 | 9.3 |
| DRY 19 - 86 m | 86 | -26.6 | 8.3 |
| DRY 19 - 87.16 m | 87.16 | -25.9 | 7.5 |
| DRY 19 - 89.33 m | 89.33 | -26.3 | 9.5 |
| DRY 19 - 90.45 m | 90.45 | -26.8 | 9.9 |
| DRY 19 - 91.31 m | 91.31 | -26.3 | 8.6 |
| DRY 19 - 92.44 m | 92.44 | -26.9 | 9.5 |
| DRY 19 - 94 m | 94 | -26.1 | 7.7 |
| DRY 19 - 95.06 m | 95.06 | -26.4 | 8.2 |
| DRY 19 - 96 m | 96 | -26.2 | 8.1 |
| DRY 19 - 97 m | 97 | -27.0 | 11.0 |
| DRY 19 - 98 m | 98 | -26.9 | 9.5 |
| DRY 19 - 99.1 m | 99.1 | -25.3 | 7.6 |
| DRY 19 - 100.6 m | 100.6 | -26.1 | 7.8 |
| DRY 19 - 101 m | 101 | -27.0 | 9.3 |
| DRY 19 - 102 m | 102 | -26.7 | 8.3 |
| DRY 19 - 103 m | 103 | -26.5 | 9.8 |
| DRY 19 - 109.08 m | 109.8 | -26.9 | 7.4 |
| **Sample Name** | **Outcrop Position (m)** | **δ13Corg (‰ vs. VPDB)** | **C:N ratio (n/n)** |
| DRY 19 - 109.75 m | 109.75 | -26.7 | 7.5 |
| DRY 19 - 111.21 m | 111.21 | -26.2 | 7.8 |
| DRY 19 - 112.25 m | 112.25 | -26.9 | 8.2 |
| DRY 19 - 113.07 m | 113.07 | -27.3 | 12.0 |
| DRY 19 - 115.65 m | 115.65 | -26.9 | 8.1 |
| DRY 19 - 117.1 m | 117.1 | -26.4 | 7.5 |
| DRY 19 - 117.5 m | 117.5 | -26.2 | 6.3 |
| DRY 19 - 118.45 m CC | 118.45 | -25.5 | 65.0 |
| DRY 19 - 122.95 m | 122.95 | -26.6 | 9.9 |
| DRY 19 - 123.66 m | 123.66 | -26.5 | 8.6 |
| DRY 19 - 127.17 m | 127.17 | -26.4 | 7.9 |
| DRY 19 - 127.45 m | 127.45 | -26.5 | 6.9 |
| DRY 19 - 128.79 m | 128.79 | -26.7 | 7.5 |
| DRY 19 - 129.98 m OL | 129.98 | -27.6 | 48.7 |
| DRY 19 - 130.72 m | 130.72 | -27.1 | 26.5 |
| DRY 19 - 132.29 m | 132.29 | -27.1 | 12.1 |
| DRY 19 - 134.3 m | 134.3 | -26.6 | 7.6 |
| DRY 19 - 135 m | 135 | -26.5 | 7.9 |
| DRY 19 - 136 m | 136 | -26.9 | 7.3 |
| DRY 19 - 136.93 m | 136.93 | -27.1 | 8.9 |
| DRY 19 - 138.02 m | 138.02 | -27.0 | 10.0 |
| DRY 19 - 139.11 m | 139.11 | -26.9 | 8.2 |
| DRY 19 - 140.12 m | 140.12 | -26.9 | 8.5 |
| DRY 19 - 141.11 m | 141.11 | -26.8 | 7.9 |
| DRY 19 - 142.24 m | 142.24 | -26.5 | 6.7 |
| DRY 19 - 142.76 m CC | 142.76 | -26.7 | 45.6 |
| DRY 19 - 147.11 m | 147.11 | -26.5 | 9.1 |
| DRY 19 - 147.95 m | 147.95 | -26.9 | 7.2 |
| DRY 19 - 149.27 m | 149.27 | -26.2 | 8.3 |
| DRY 19 - 149.83 m | 149.83 | -26.5 | 9.6 |
| DRY 19 - 150.85 m | 150.85 | -26.3 | 8.0 |
| DRY 19 - 151.98 m | 151.98 | -26.8 | 9.1 |
| DRY 19 - 152.72 m | 152.72 | -26.4 | 7.7 |
| DRY 19 - 154 m | 154 | -26.5 | 8.3 |
| DRY 19 - 154.8 m | 154.8 | -26.3 | 7.5 |
| DRY 19 - 155.9 m | 155.9 | -26.6 | 6.9 |
| DRY 19 - 157.09 m | 157.09 | -26.3 | 6.7 |
| DRY 19 - 159.01 m | 159.01 | -27.0 | 8.4 |
| DRY 19 - 160.16 m | 160.16 | -26.5 | 6.8 |
| DRY 19 - 161.36 m | 161.36 | -26.3 | 7.5 |
| DRY 19 - 162.02 m | 162.02 | -26.6 | 9.8 |
| DRY 19 - 162.98 m | 162.98 | -27.0 | 6.3 |
| DRY 19 - 163.96 m | 163.96 | -26.4 | 7.5 |
| **Sample Name** | **Outcrop Position (m)** | **δ13Corg (‰ vs. VPDB)** | **C:N ratio (n/n)** |
| DRY 19 - 165.05 m | 165.05 | -26.5 | 7.9 |
| DRY 19 - 166.02 m | 166.02 | -26.7 | 9.2 |
| DRY 19 - 167.01 m | 167.01 | -26.7 | 7.7 |
| DRY 19 - 169.23 m | 169.23 | -26.3 | 7.5 |
| DRY 19 - 170.04 m | 170.04 | -27.3 | 14.1 |
| DRY 19 - 170.45 m TC | 170.45 | -26.8 | 13.7 |
| DRY 19 - 170.88 m TC | 170.88 | -26.9 | 8.3 |
| DRY 19 - 171.18 m TC | 171.18 | -26.9 | 6.0 |
| DRY 19 - 171.33 m TC | 171.33 | -27.3 | 11.2 |
| DRY 19 - 172.02 m | 172.02 | -27.2 | 9.6 |
| DRY 19 - 173.18 m TC | 173.18 | -27.6 | 12.1 |
| DRY 19 - 173.33 m OL | 173.33 | -27.8 | 37.0 |
| DRY 19 - 174.19 m | 174.19 | -26.9 | 10.8 |
| DRY 19 - 174.99 m | 174.99 | -27.2 | 9.7 |
| DRY 19 - 176.03 m | 176.03 | -26.7 | 9.6 |
| DRY 19 - 177.11 m | 177.11 | -26.8 | 9.9 |
| DRY 19 - 178.29 m | 178.29 | -26.8 | 11.5 |
| DRY 19 - 179 m | 179 | -27.4 | 10.5 |
| DRY 19 - 180.03 m | 180.03 | -26.8 | 8.4 |
| DRY 19 - 181.04 m | 181.04 | -27.4 | 11.1 |
| DRY 19 - 183.10 m | 183.1 | -27.1 | 10.8 |
| DRY 19 - 184 m | 184 | -26.8 | 9.9 |
| DRY 19 - 186.03 m | 186.03 | -26.8 | 8.7 |
| DRY 19 - 187.1 m | 187.1 | -27.1 | 8.9 |
| DRY 19 - 187.93 m | 187.93 | -26.8 | 8.0 |
| DRY 19 - 189 m | 189 | -26.6 | 8.9 |
| DRY 19 - 193.03 m | 193.03 | -26.5 | 8.0 |
| DRY 19 - 194.25 m | 194.25 | -27.0 | 7.6 |
| DRY 19 - 195.01 m | 195.01 | -26.3 | 7.0 |
| DRY 19 - 196.08 m | 196.08 | -26.8 | 6.0 |
| DRY 19 - 197 m | 197 | -27.2 | 7.9 |
| DRY 19 - 198.02 m | 198.02 | -26.1 | 6.2 |
| DRY 19 - 199 m | 199 | -27.1 | 10.1 |
| DRY 19 - 200 m | 200 | -26.7 | 7.8 |