**Appendix A: Supplementary information for:**

**Eurasian Ice Sheet derived meltwater pulses and their role in driving atmospheric dust activity: Late Quaternary loess sources in SE England**

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**1. Nd isotope signatures of loess at Pegwell Bay and potential source sediments in the North Sea region**

Table : Nd isotope signature of Pegwell Bay loess samples, reference samples SST, BMT, MRW, 155VC and PBTF (this study) and published data from glacigenic sediments along the BIIS and FIS margin and fluvial sediments carried by rivers draining central Continental Europe (Freslon et al., 2014; Toucanne et al., 2015)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Location** | **Sample code** | **Sediment type** | **Age** | **Lat.** | **Long.** | **143Nd/144Nd** | **2SD** | **εNd** | **2SD** | **Reference** |
|  |  |  |  |  |  |  |  |  |  |  |
| ***Loess at Pegwell Bay*** |  |  |  |  |  |  |  |  |
| *Second accumulation phase* |  |  |  |  |  | *-12.5* | *0.4* |  |
| Pegwell Bay | PB70 | Loess | MIS 2 | 51.328 | 1.370 | 0.51196613 | 0.00002 | -13.1 |  | This study |
| Pegwell Bay | PB100 | Loess | MIS 2 | 51.328 | 1.370 | 0.51201 | 0.00002 | -12.3 |  | This study |
| Pegwell Bay | PB120 | Loess | MIS 2 | 51.328 | 1.370 | 0.511986 | 0.000017 | -12.7 |  | This study |
| Pegwell Bay | PB150 | Loess | MIS 2 | 51.328 | 1.370 | 0.512013 | 0.000015 | -12.2 |  | This study |
| Pegwell Bay | PB180 | Loess | MIS 2 | 51.328 | 1.370 | 0.512005 | 0.00002 | -12.3 |  | This study |
| *Fist accumulation phase* |  |  |  |  |  | *-12.5* | *0.3* |  |
| Pegwell Bay | PB210 | Loess | MIS 2 | 51.328 | 1.370 | 0.511984 | 0.00002 | -12.8 |  | This study |
| Pegwell Bay | PB240 | Loess | MIS 2 | 51.328 | 1.370 | 0.511984 | 0.00002 | -12.8 |  | This study |
| Pegwell Bay | PB260 | Loess | MIS 2 | 51.328 | 1.370 | 0.511989 | 0.000014 | -12.7 |  | This study |
| Pegwell Bay | PB280 | Loess | MIS 2 | 51.328 | 1.370 | 0.512002 | 0.000019 | -12.4 |  | This study |
| Pegwell Bay | PB310 | Loess | MIS 2 | 51.328 | 1.370 | 0.512018 | 0.000017 | -12.1 |  | This study |
|  |  |  |  |  |  |  |  |  |  |  |
| ***Reference samples*** |  |  |  |  |  |  |  |  |  |
| *BIIS (East UK)* |  |  |  |  |  |  | *-13.8* | *1.2* |  |
| Holderness | SST | Skipsea till | MIS 2 | 53.996 | 0.209 | 0.511903289 | 0.000015 | -14.3 |  | This study |
| Holderness | BMT | Basement till  | MIS 2 | 53.328 | 0.11 | 0.511863141 | 0.000018 | -15.1 |  | This study |
| Happisburgh | HPB1 | Till  | MIS 12 | 52.826 | 1.533 | 0.511996 | 0.000007 | -12.5 |  | Toucanne et al. (2015) |
| Filey Bay | FLD1 | Filey Till  | MIS 2 | 54.207 | -0.284 | 0.511903 | 0.000005 | -14.3 |  | Toucanne et al. (2015) |
| Filey Bay | FMD1 | Filey Till  | MIS 2 | 54.207 | -0.284 | 0.511994 | 0.000006 | -12.6 |  | Toucanne et al. (2015) |
|  |  |  |  |  |  |  |  |  |  |  |
|  *FIS (Northern European Plain)* |  |  |  |  |  | *-15.1* | *1.1* |  |
| Knud Strand | KSS1 | Glaciolacustrine (Spøttrup. Fegge Clay) | MIS 2 | 56.658 | 8.777 | 0.511851 | 0.000006 | -15.4 |  | Toucanne et al. (2015) |
| Rubjerg Knude | LKFm1 | Glaciolacustrine (Lønstrup Klint Fm) | MIS 2 | 57.45 | 9.778 | 0.511777 | 0.000006 | -16.8 |  | Toucanne et al. (2015) |
| Rubjerg Knude | RKNFm1 | Glaciofluvial (Rubjerg Knude Fm) | MIS 2 | 57.45 | 9.778 | 0.511838 | 0.000008 | -15.6 |  | Toucanne et al. (2015) |
| Rubjerg Knude | RIBFm1 | Glaciofluvial (Ribjerg Fm) | MIS 2 | 57.45 | 9.778 | 0.51185 | 0.000007 | -15.4 |  | Toucanne et al. (2015) |
| Karup | KAR1 | Glaciofluvial (Karup Sandur Fm) | MIS 2 | 56.312 | 9.185 | 0.511969 | 0.000006 | -13.1 |  | Toucanne et al. (2015) |
| Travemünde | S1 | Glaciofluvial | MIS 2 | 53.971 | 10.883 | 0.512001 | 0.000006 | -12.4 |  | Toucanne et al. (2015) |
| Travemünde | S5 | Glaciofluvial  | MIS 2 | 53.971 | 10.883 | 0.51191 | 0.000005 | -14.2 |  | Toucanne et al. (2015) |
| Beelitz | BEE-a | Glaciofluvial | MIS 2 | 52.288 | 12.937 | 0.511925 | 0.000005 | -13.9 |  | Toucanne et al. (2015) |
| Beelitz | BEE-b | Glaciofluvial | MIS 2 | 52.288 | 12.937 | 0.511929 | 0.000006 | -13.8 |  | Toucanne et al. (2015) |
| Althüttendorf | ALT-a | Glaciofluvial | MIS 2 | 52.963 | 13.872 | 0.51179 | 0.000006 | -16.5 |  | Toucanne et al. (2015) |
| Althüttendorf | ALT-b | Glaciofluvial | MIS 2 | 52.963 | 13.872 | 0.51183 | 0.000005 | -15.8 |  | Toucanne et al. (2015) |
| Macherslust | MAC-a | Glaciofluvial | MIS 2 | 52.848 | 13.838 | 0.511876 | 0.000003 | -14.9 |  | Toucanne et al. (2015) |
| Macherslust | MAC-b | Glaciofluvial | MIS 2 | 52.848 | 13.838 | 0.511837 | 0.000005 | -15.6 |  | Toucanne et al. (2015) |
| Trzciniec | TRZ | Glaciofluvial | MIS 2 | 53.086 | 17.945 | 0.511913 | 0.000006 | -14.1 |  | Toucanne et al. (2015) |
| Oborki | OBK | Till | MIS 2 | 53.152 | 19.381 | 0.511811 | 0.000006 | -16.1 |  | Toucanne et al. (2015) |
| Kozlowo | KZL | Till | MIS 2 | 53.341 | 18.341 | 0.511825 | 0.000006 | -15.9 |  | Toucanne et al. (2015) |
| Glaznoty | GLZ | Till | MIS 2 | 53.535 | 19.904 | 0.511827 | 0.000006 | -15.8 |  | Toucanne et al. (2015) |
| Chrostkowo | CHK1 | Diamict | MIS 2 | 52.943 | 19.253 | 0.511894 | 0.000006 | -14.5 |  | Toucanne et al. (2015) |
| Chrostkowo | CHK2 | Diamict | MIS 2 | 52.943 | 19.253 | 0.511855 | 0.000006 | -15.3 |  | Toucanne et al. (2015) |
| Karchowo | ST/12 | Glaciofluvial | MIS 2 | 51.889 | 16.834 | 0.51182 | 0.000004 | -16.0 |  | Toucanne et al. (2015) |
| Karchowo | ST/13 | Glaciofluvial | MIS 2 | 51.889 | 16.834 | 0.511888 | 0.000008 | -14.6 |  | Toucanne et al. (2015) |
| Karchowo | ST/14 | Glaciofluvial | MIS 2 | 51.889 | 16.834 | 0.511844 | 0.000004 | -15.5 |  | Toucanne et al. (2015) |
| Hetmanice | ST/15 | Glaciofluvial | MIS 2 | 51.858 | 16.265 | 0.511921 | 0.000006 | -14.0 |  | Toucanne et al. (2015) |
| Hetmanice | ST/16 | Glaciofluvial | MIS 2 | 51.858 | 16.265 | 0.511792 | 0.000004 | -16.5 |  | Toucanne et al. (2015) |
| Hetmanice | ST/17 | Glaciofluvial | MIS 2 | 51.858 | 16.265 | 0.511874 | 0.000005 | -14.9 |  | Toucanne et al. (2015) |
|  |  |  |  |  |  |  |  |  |  |  |
| *Central Continental Europe* |  |  |  |  |  | *-11.0* | *1.4* |  |
| Rhine | MRW | fluvial  | modern | 51.66 | 6.508 | 0.512183 | 0.000003 | -8.9 |  | This study |
| Ems |  | fluvial  | modern | 53.231 | 7.405 | 0.512028 | 0.000008 | -11.9 |  | Toucanne et al. (2015) |
| Wesera |  | fluvial  | modern | 53.539 | 8.572 | 0.512178 | 0.000009 | -9.0 |  | Freslon et al. (2014) |
| Elbea |  | fluvial  | modern | 53.703 | 9.449 | 0.512058 | 0.000009 | -11.3 |  | Freslon et al. (2014) |
| Varde |  | fluvial  | modern | 55.632 | 8.507 | 0.512025 | 0.000007 | -12.0 |  | Toucanne et al. (2015) |
| Oder |  | fluvial  | modern | 53.841 | 14.121 | 0.512003 | 0.000013 | -12.4 |  | Toucanne et al. (2015) |
| Schelde |  | fluvial  | modern | 51.74 | 3.978 | 0.512056 | 0.000015 | -11.4 |  | Toucanne et al. (2015) |
|  |  |  |  |  |  |  |  |  |  |  |
| *Other reference samples* |  |  |  |  |  |  |
| Dogger lake | 155VC | Glaciolacustrine  | MIS 2 | 55.38 | 1.32 | 0.511900273 | 0.000018 | -14.4 |  | This study |
| Pegwell Bay | PBTF | Thanet Fm. | Palaeocene | 51.328 | 1.370 | 0.512006 | 0.000005 | -12.3 |  | This study |

**2. Zircon age compilation from proto source terranes**

References used in the zircon age compilation from proto source terranes (Fig. 7, 8 and Appendix A: Fig. 1; expanded after Bingen and Solli, 2009; Fairey et al., 2018; Baykal et al., 2021; Bingen et al., 2021; Stevens and Baykal, 2021): **Laurentia** (Cawood et al., 2003; 2012; Friend et al., 2003; Kirkland et al., 2008b; Waldron et al., 2008; 2014; McAteer et al., 2010; Strachan et al., 2013; Johnson et al., 2016)**; Ganderia** (Fyffe et al., 2009; Waldron et al., 2014; 2019; Willner et al., 2014)**; Megumia** (Waldron et al., 2009; 2011; Pothier et al., 2015; White et al., 2018)**; British Avalonia** (Collins and Buchan, 2004; Murphy et al., 2004; Strachan et al., 2007)**;**  **Caledonides** (Schärer, 1980; Claesson et al., 1988; 1983; Claesson, 1987; Dunning and Pedersen, 1988; Nordgulen and Schouenborg, 1990; Tucker et al., 1990; 2004; Pedersen et al., 1991; Roberts and Tucker, 1991; 1998; Corfu and Emmett, 1992; Nordgulen et al., 1993; 2002; Bjerkgård and Bjørlykke, 1994; Northrup, 1997; Pedersen and Dunning, 1997; Dunning and Grenne, 2000; Bingen et al., 2001b; Svenningsen, 2001; Vaasjoki and Sipilä, 2001; Bingen et al., 2005b; 2011; Corfu and Andersen, 2002; Hartz et al., 2002; Paulsson and Andréasson, 2002; Roberts et al., 2002; 2006; Yoshinobu et al., 2002; Andréasson et al., 2003; Corfu et al., 2003a; 2006; Nilsen et al., 2003; 2007; Rehnström, 2003; Corfu, 2004b; Rehnström and Corfu, 2004; Kirkland et al., 2005; 2006; 2007b; 2007a; 2008a; 2011; Nissen et al., 2006; Barnes et al., 2007; Austrheim and Corfu, 2009; Be’eri-Shlevin et al., 2011; Smit et al., 2011; Gee et al., 2015; Slagstad and Kirkland, 2017); **Basement windows in the Caledonides** (Corfu, 1980; 2004a; 2007; Romer et al., 1991; Schouenborg et al., 1991; Johansson et al., 1993b; Skår et al., 1994; Skår, 2002; Larsen et al., 2002; Austrheim et al., 2003; Rehnström and Torsvik, 2003; Skar and Pedersen, 2003; Corfu et al., 2003b; Rehnström and Corfu, 2004; Røhr et al., 2004; Tucker et al., 2004; Kullerud et al., 2006; Bergh et al., 2007; Kirkland et al., 2008a); **Telemarkia** (Pasteels and Michot, 1975; Pasteels et al., 1979; Heaman and Smalley, 1994; Zhou et al., 1995; Schärer et al., 1996; Bingen and Van Breemen, 1998; De Haas et al., 1999; Andersen et al., 2002b; 2002a; Bingen et al., 2008b; 2015; Andersen et al., 2004a; Laajoki et al., 2002; Möller et al., 2002; 2003; Andersen et al., 2007; Bingen et al., 2002; 2003; 2005a; 2006; Brewer et al., 2004; Laajoki and Corfu, 2007; Corfu and Laajoki, 2008; Pedersen et al., 2009; Lamminen, 2011; Vander Auwera et al., 2011; 2014; Roberts et al., 2013; Slagstad et al., 2013; 2018; Spencer et al., 2014; Coint et al., 2015; Scheiber et al., 2015; Jensen and Corfu, 2016; Bolle et al., 2018; Bingen and Viola, 2018); **Kongsberg** (Bingen et al., 2001a; 2005a; Andersen et al., 2004b; Scheiber et al., 2015; Bingen and Viola, 2018); **Bamble** (Knudsen et al., 1997; Åhäll et al., 1998; De Haas et al., 1999; 2002; Knudsen and Andersen, 1999; Andersen et al., 2002b; 2004b; Engvik et al., 2011; 2016; 2017; Slagstad et al., 2018; Bingen and Viola, 2018); **Oslo Rift** (Kristoffersen et al., 2014); **Idefjorden** (Welin et al., 1982; Persson et al., 1983; Welin and Samuelsson, 1987; Lundqvist and Skiöld, 1992; Åhäll et al., 1995; 1998; 2000; Connelly and Åhäll, 1996; Åhäll and Connelly, 1998; 2008; Åhäll and Schöberg, 1999; Larson et al., 1999; Scherstén et al., 2000; Bingen et al., 2001a; 2005a; 2008a; 2021; Alm et al., 2002; Andersson et al., 2002; Kiel et al., 2003; Andersen et al., 2004b; Hegardt et al., 2005; Ahlin et al., 2006; Årebäck et al., 2008; Lamminen et al., 2011; Eliasson et al., 2012; Petersson et al., 2015a; Bingen and Viola, 2018); **Eastern Segment** (Jarl and Johansson, 1988; Hansen and Lindh, 1991; Johansson et al., 1993a; Lindh et al., 1994; Welin, 1994; Persson et al., 1995; Connelly and Åhäll, 1996; Söderlund, 1996; Åhäll et al., 1997; Möller and Söderlund, 1997; Wang et al., 1998; Christoffel et al., 1999; Claeson, 1999; Larson et al., 1999; Lundqvist and Persson, 1999; Andersson et al., 1999; Söderlund et al., 1999; 2002; 2004; 2008; Andersson et al., 2002; Scherstén et al., 2000; Alm et al., 2002; Jarl, 2002; Čečys et al., 2002; Hegardt et al., 2005; Söderlund and Ask, 2006; Möller et al., 2007; 2015; Rimša et al., 2007; Appelquist et al., 2008; Bingen et al., 2008a; Andersen et al., 2009; Lamminen et al., 2011; Eliasson et al., 2012; Brander et al., 2012; Hansen et al., 2015; Petersson et al., 2015b; 2017; Piñán Llamas et al., 2015; Ulmius et al., 2015; Beckman et al., 2017); **Transcandinavian Igneous Belt** (Morton et al., 2008; Gee et al., 2014; Pulsipher and Dehler, 2019); **Svecofennia** (Claesson et al., 1993; Bergman et al., 2008; Morton et al., 2008; Lahtinen et al., 2009; 2017); **Armorican Massif** (Ballouard et al., 2018; Lin et al., 2019; Dabard et al., 2021)**; Massif Central** (Melleton et al., 2010; Chelle-Michou et al., 2017; Padel et al., 2017; Couzinié et al., 2019)**; Brabant Massif** (Linnemann et al., 2012)**; Rhenish Massif/Ardenne-Eifel** (Willner et al., 2013; Kołtonik et al., 2018; Mende et al., 2019; Herbosch et al., 2020)**; Mid-German Crystalline Rise** (Gerdes and Zeh, 2006; Zeh and Gerdes, 2010; Dörr et al., 2017; 2021; Kirchner and Albert, 2020; Zieger et al., 2020) **Western Moldanubia** (Kober et al., 2004)**; Alps** (Zimmermann et al., 2018; Lu et al., 2019; 2020; Anfinson et al., 2020; Chang et al., 2021)**; Saxothuringian** (Kryza et al., 2007; Linnemann et al., 2007; Jastrzěbski et al., 2010; Mazur et al., 2012; Žáčková et al., 2012; Zieger et al., 2019); **Tepla-Barrandian** (Strnad and Mihaljevič, 2005; Sláma et al., 2008; Drost et al., 2011)**; Eastern Moldanubia** (Košler et al., 2014)**;**  **Moravo-Silesia** (Habryn et al., 2020; Jastrzębski et al., 2021); **Magura Nappe** (Bónová et al., 2019; 2020)

**3. Multi-dimensional scaling map of detrital zircon U-Pb age data from Pegwell Bay loess, potential source sediment samples and proto-source terranes**



Figure : Non-metric multi-dimensional scaling (MDS; Vermeesch, 2013) map using the Kolmogorov-Smirnov (KS) statistic for the zircon age data from loess at Pegwell Bay (PB130-150; PB210-230; this study), Palaeocene Thanet Fm. sands (PBTF; Stevens and Baykal, 2021), the MIS 2 Skipsea Till (SST; this study); MIS 2 Dogger lake sediment (155VC; this study), Neogene sediments in the southwestern North Sea basin (WNS; Verhaegen et al., 2021), Quaternary Rhine sediments (RTe; Krippner and Bahlburg, 2013), MIS 2 sandur sediments from the Northern European Plain (SSS; Baykal et al., 2021), the Late Pleistocene Black Till (BT, Knudsen et al., 2009) and Miocene deltaic sediments in the southeastern North Sea basin (ENS; Olivarius et al., 2014), alongside zircon age data compiled from potential protosource terranes (expanded after Bingen and Solli (2009); Fairey et al. (2018); Baykal et al. (2021); Bingen et al. (2021); Stevens and Baykal (2021); see Appendix A for references; see Fig. 7 for simplified arrangement of potential protosource terranes; see key for protosource terranes shown in Fig. 8, except number “14” (Svecofennia)). Axes are dimensionless “K-S units” of the distance between samples. Solid and dashed lines connect samples with their closest and second closest neighbours, respectively.

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