

PPSP: a new program for plotting peatland stratigraphy

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SUMMARY

This short article is an introduction to a new open-source program that enables the production of quality plots of Troels-Smith data predominantly for peatlands. Here the potential of the program and the distinct general concept behind it is described. The strengths and potential for development are explored. Functionality is demonstrated using real and fictional data.

KEY WORDS: charcoal, open-source, peat, python, Troels-Smith, von Post

INTRODUCTION

Palaeo-environmental and palaeoecological analyses often employ the Troels-Smith (1955) scheme in the field to record broad changes in the palaeo archive. Popular uses are for records from lake and saltmarsh sediments and peatlands. Sediments when cored are sectioned visually either in the field or laboratory and changes recorded based on a series of sedimentary and physical properties. Some palaeo plotting programs (Tilia, [Tilia - NeotomaDB](https://chrono.qub.ac.uk/psimpoll/psimpoll.html)), Psimpol (<https://chrono.qub.ac.uk/psimpoll/psimpoll.html>), POLPAL (Nalepka & Walanus 2003) and Rioja (Juggins 2022) have the ability to display single core Troels-Smith data next to a palaeo diagram of a particular proxy such as pollen, macrofossils or diatoms. PPSP (Python Peat Stratigraphy Plotter) is designed purely to produce figures that display the stratigraphy of multiple (two or more) cores. Cores can be configured to display primarily Troels-Smith data but also values from field based von Post (von Post 1922, 1924) humification analyses and charcoal assessments. TSPPLus (Waller *et al.* 1995), a DOS based program, was designed to complete this task employing traditional Troels-Smith based symbology. There appears to be no updated version of that program. PPSP is not a direct replacement for TSPPLus and is focused on the stratigraphy of peatlands, employing a different approach to that of the traditional symbology. In relatively simple stratigraphic systems such as peatlands the approach taken by PPSP strives to enable substantial detail to be displayed.

PPSP is written using Python 3 (<https://www.python.org/>, version 3.13.7) and primarily makes use of the built-in drawing module 'Turtle' along with three dependencies including pandas 2.3.1 (The pandas development team 2025),

NumPy 2.3.3 (Harris *et al.* 2020) and pillow 10.4.0 (Clark 2015). Although production of quality plots of stratigraphy specific to peatlands is the primary objective of PPSP, the program could potentially be used in other environments such as lakes or saltmarshes. PPSP is free open-source software supplied with a GPL v.3.0 licence and is available from Zenodo (Blundell 2025). This article aims to briefly outline the general operation and functionality of the PPSP plotting program.

GENERAL OUTLINE OF PPSP

The full instructions of how to use PPSP are not outlined here but are contained in a manual (PPSP_manual.pdf) included in the download (Blundell 2025). The manual provides steps for the most convenient setup of the program in Windows (10, 11), Linux and MacOS operating systems via a virtual environment. All available functionality provided by PPSP is covered in the manual but the main features and general concepts around the program's operation will be covered here. When downloading from Zenodo the user should take care to obtain the latest version that has been uploaded. The range of PPSP functionality is demonstrated using example peatland-based records from Keighley Moor in Yorkshire, UK (53° 85' 31" N, -02° 02' 13" E), and a fictitious transect devised by the author.

The python code consists of four modules namely PPSP_strat.py, PPSP_options.py, PPSP_build.py and PPSP_colours.py. Modules are largely functional in programming style. PPSP_strat.py is the main module that draws information from the others to enable successful figure construction. PPSP_strat.py also contains the functions to draw specific shapes and features that make up the figure. User inputs



controlling the aesthetics of these features are collated by `PPSP_options.py` and `PPSP_colours.py`. `PPSP_build.py` takes data from the ‘data’ file, such as number of cores, distance between them and ranges in altitudes, and processes these so `PPSP_strat.py` can formulate a suitably scaled layout on the computer monitor. Unless the user wishes to further develop the code, all four modules should remain unaltered.

Interaction with PPSP is like that with P4 (Blundell 2023) in that the user edits two csv files, a ‘parameter’ file and a ‘data’ file. The former file contains all the parameters that the user can change to alter the appearance of the resulting figure, and the latter contains the recorded core stratigraphy data. Seven example pairs of data and parameter files are provided in the downloaded program bundle, five based on a transect from Keighley Moor (Blundell & Holden 2014) and two on a fictitious transect. These files are filled with all the data and parameters so that the user can quickly produce these figures and, by way of altering the entries, become accustomed to how the program works. The parameter file has 15 groups of parameters that the user can adjust (Figure 1). Some individual parameters (marked with double **) must have entries for the program to function. Filling out the data file is a simple process with four groups of columns related to data entry; for a) Troels-Smith and von Post measures, b) charcoal, c) an ‘other’ optional presence/absence type and d) core labels. Full details of how to fill out parameter and data files are provided in the manual.

Once parameter and data files have been edited with the user’s options and data, the program can be run. The program is set up to be run from the command line or terminal. Users should not be put off by command line usage as this is minimal after the program has been set up. Running the program requires a) navigation to the folder where the program, parameter and data files are, b) activation of the created virtual environment and c) inputting the following statement:

```
Python PPSP.strat.py -input g:\PPSP
name_of_parameter_file.csv
```

The statement is the word ‘python’ followed by a space, the name of the main module ‘`PPSP.strat.py`’ followed by a space, two hyphens, the word ‘input’ followed by a space, the location of the program and user files (`g:\PPSP`, here as in the manual, a USB stick drive with a folder named PPSP) followed by a space and lastly the name of the parameter file with the `.csv` extension. Once the statement is typed, and the program is run, subsequent retyping of the statement is not required for further program iterations as the up and down cursor keys allow the

user to access previous statements in the command line window.

By editing a few lines of code, as directed by the comments in the `PPSP_strat.py` module, experienced python users will be able to run PPSP from an integrated development environment (IDE) if that is preferred. Upon running the program, the resultant figure will be displayed within a window (canvas). The user can tailor the dimensions of this window in the parameter file, to fit on their monitor. Extensive error capture and messaging is built into the program and should facilitate rectifying any issues encountered. Once a figure is displayed, iterations of adjusting entries in the data or parameter file and re-running the program are often required to produce the desired figure (Figure 1). The lack of a Graphical User Interface (GUI) makes this a remarkably quick process after relatively little experience. The program runs within a few seconds meaning it is time efficient to run numerous iterations to achieve the desired figure. Successful running of the program produces (by default) an Encapsulated Postscript (eps) output file of the figure which is named by the user in the parameter file; png or jpg formats are optional.

Troels-Smith

Traditionally, Troels-Smith data is shown using ‘Troels-Smith’ symbols consisting of different black and white patterns for individual categories. These patterns can become confusing when a core section has a mix of Troels-Smith symbols (Figure 2). The patterns are not ideal for depicting the details of very short core sections where it may not be possible to accommodate the symbol. In these circumstances users would typically simplify the data by omitting the short sections to aid presentation. PPSP uses four vertical rectangles of equal width (25 % each) within every core section (except for the geology or basal sediment). Each rectangle is assigned a Troels-Smith category (see manual for Troels-Smith category abbreviations) and a defining colour. A section completely full of mosses would be given a Tb-Tb-Tb-Tb assignment in the data file and be shown in Figure 2 as four green rectangles. A section with 50 % sedge and 50 % mosses would be assigned a Th-Th-Tb-Tb notation and be seen in Figure 2 as two yellow rectangles followed by two green. This makes it clear what the Troels-Smith measure (1–4) is for each assignment. Visualising the data like this permits detail to be seen in even very shallow sections. Most people read journals as digital copies, permitting extensive use of colour and magnification. The highly detailed peat stratigraphy in Figures 3–5 could not be represented clearly using the traditional symbology. Although PPSP uses the traditional Latin

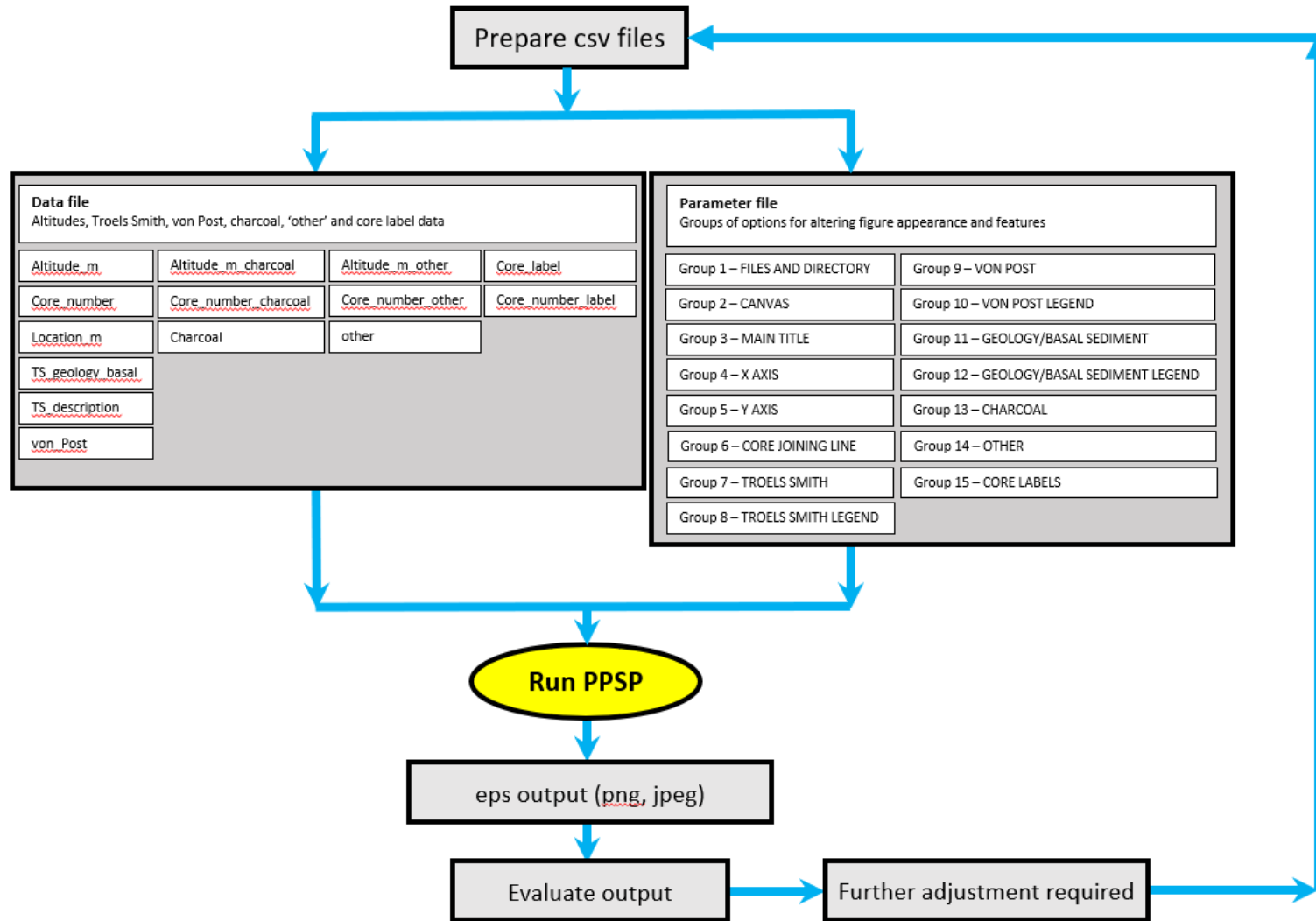


Figure 1. Flow diagram displaying the process of creating a plot in PPSP. Troels-Smith and optional von Post, charcoal and 'other' inputs are provided in the data file. Options for altering the appearance of the figure are specified via the 15 groupings in the parameter file. The PPSP program is run and the figure inspected. Adjustment of entries in data and/or parameter files is continued until the user is satisfied with the figure.

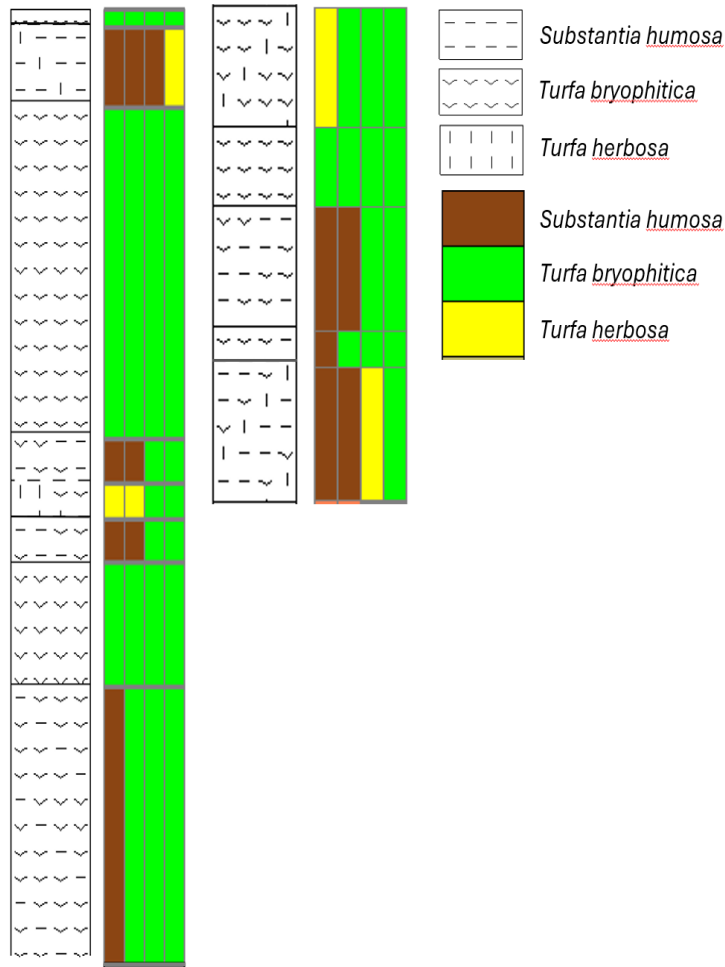


Figure 2. Examples of two cores with traditional Troels-Smith patterns versus the approach taken by PPSP.

terms from the Troels-Smith scheme by default, the user can provide an alternative name in the parameter file, to be displayed in the legend. For example, *Turfa bryophitica* could be renamed as ‘Moss peat’ and *Turfa lignosa* as ‘Wood peat’.

Relying on colours alone in scientific outputs may create figures that are difficult for people affected by colour blindness to decipher (Crameri *et al.* 2020). However, for peat cores the organic sections will be limited to four colours depicting Tb, Th, Tl or Sh and can be represented in shades of grey plus black and white (Figure 5), which is less problematic (Crameri *et al.* 2020). If added complexity is introduced by a mineral layer at the base, PPSP offers the addition of some default symbols that can be combined with a background colour for clay (*Argilla steatodes*) through to gravel (*Grana glareosa majora*). This is not always necessary but may be advantageous if displaying a figure entirely in greyscale. The wide colour choice available in the program together with the limited symbol selection for mineral components should provide flexibility.

von Post

The infield measure of decomposition known as the von Post scale (von Post 1922, 1924) is widely used in the peatland community and is routinely recorded within the same defined sections as those for the Troels-Smith assessment. In PPSP these data are plotted for each section of a core in a separate neighbouring column (Figures 3–6). The von Post scale ranges from 1 (completely undecomposed) to 10 (completely decomposed) and is displayed by PPSP using colours assigned by the user in the parameter file. Here and in the manual a graded brown colour scheme is used. If a greyscale is used it would be advisable to group colours, for example into H1–2, H3–4, H5–6, H7–8 and H9–10 (Figure 5).

Geology/basal sediment

Typically, in a peatland environment, a core at depth will grade into a mix of organic and mineral material, and bedrock may be encountered. Mineral assignments in the Troels-Smith scheme are used in PPSP to display an organo-mineral or mineral

substrate but the user can also display the known bedrock. PPSP is not an expert geological logging tool. At present, ten simple patterns are included to allow basic depiction of underlying geology/sediment. Patterns used are those often employed in the geology community, however the name assigned to any of the patterns can be changed by the user so none of the patterns are fixed to any specific geology. The fictitious data example in Figure 6 has an unlikely variety of different geologies in a range of colours to display some of the possibilities.

Displaying presence/absence data

Charcoal is a key indicator of natural and (often) active anthropogenic burning in many palaeo-archives. For peatlands, charcoal can be commonly identified in core sections in the field and recorded in a presence/absence format. PPSP displays charcoal records as a further column parallel to the main Troels-Smith data. There is a limit to the number of columns that can be placed parallel to the main Troels-Smith depiction that restricts the possible number of these presence/absence type displays. However, there is a single 'other' category in PPSP for one more interesting observation of this sort. This functionality is employed to highlight evidence of large wood remains in Figures 3–5, and *Phragmites* in Figure 6.

Plots using depth instead of altitude

PPSP is designed to display cores using altitude, making their relative topographic positions clear. A transect with a wide altitudinal spread significantly reduces the size of each core on a figure, thus diminishing the detail that can be seen. Splitting the transect into two or more sections is one way to reduce this effect. With some minor edits to data and parameter files PPSP facilitates an alternative, which is to plot cores using depth. In this case surface topography and relative position may be provided by the user in a separate figure.

EXAMPLE FIGURES

Seven pairs of parameter and data files are provided with the program when downloaded, five based on Transect A from a blanket peatland at Keighley Moor, Yorkshire, England (Blundell & Holden 2014) and two based on fictional data. In this article four are used to illustrate the functionality and features of PPSP. Files as supplied create figures to fit within the area provided by a 27-inch (685.8 mm) screen.

Keighley Moor Transect A (altitude style plot)

A catchment-wide stratigraphy survey was carried out at Keighley Moor (Blundell & Holden 2014) in part to establish a suitable position for a master core subjected to detailed palaeoecological analysis. One of the transects, Transect A, was nine cores in length and covered an altitudinal range of 16.92 m with core lengths <3.5 m. If all cores were displayed on a single figure (see manual), each core would be small and detail would be hard to be distinguish. This effect was reduced substantially by splitting the transect after the first five cores (Figure 3) and plotting the remaining four cores in a separate figure (not shown).

Figure 3 demonstrates a version of every main display feature PPSP has to offer. Detailed Troels-Smith data are shown with a distinct and clear colour scheme separated by bounding lines. Three parallel columns facilitate the display of a) von Post data using a brown gradient, along with b) charcoal and c) tree wood presence using black and red rectangles, respectively. The last of these employs the 'other' presence/absence facility. Underlying geology of sandstone (one of ten general geology types available) is depicted at the base of each core. Legends for Troels-Smith, von Post and geology/basal sediment have also been selected. A connecting lines feature between the surfaces and bases of adjacent cores has been used together with grid lines on the y axis to aid cross-core comparisons. Aesthetic aspects of all these plot features can be altered within the parameter and data files.

Keighley Moor Transect A (depth style plot)

Figure 4 shows the first five cores of Transect A plotted using depth as opposed to altitude. As core size depicted on the figure is maximised, clarity of detail is improved compared to Figure 3. Core detail clarity is acceptable when displayed against altitude in this case but can be less so with greater altitudinal differences (see manual). A few aesthetic changes are also evident, with dashed y axis grid lines and no core joining lines. Figure 5 is a repeat of Figure 4 but is depicted in shades of grey and black and white.

Fictitious data

Figure 6 is intended to display as much of the program's current aesthetic and plotting potential as possible using a fictional dataset. The figure produced looks strange but shows the range of functions and some variation in their appearance. Changes to colour, line type and width, text size and style are evident. Changes to geology/basal sediment features, although undesirable, do illustrate how the appearance can be altered if required.

Keighley Moor transect A (cores 15, 76, 83, 78 and master) with altitude (m)

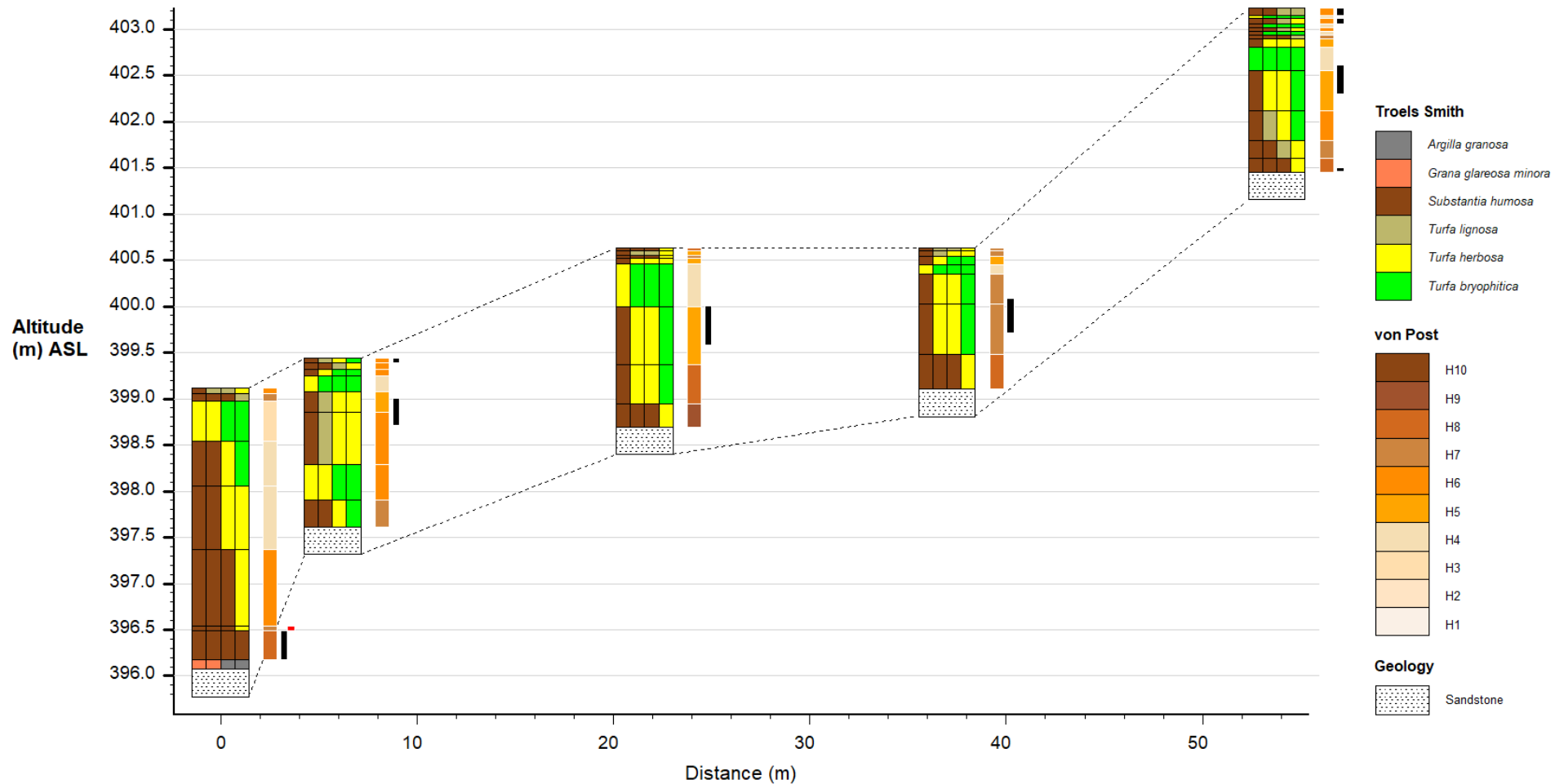


Figure 3. Stratigraphy data displayed against altitude using PPSP, for cores 15, 76, 83, 78 and master from Transect A at Keighley Moor, Yorkshire, England (Blundell & Holden 2014). Troels-Smith (left-hand column, four rectangles wide), von Post (adjacent graded brown column), charcoal (black rectangles adjacent to von Post column) and large wood remains (red rectangles adjacent to charcoal) are featured.



Keighley Moor transect A (cores 15, 76, 83, 78 and master)

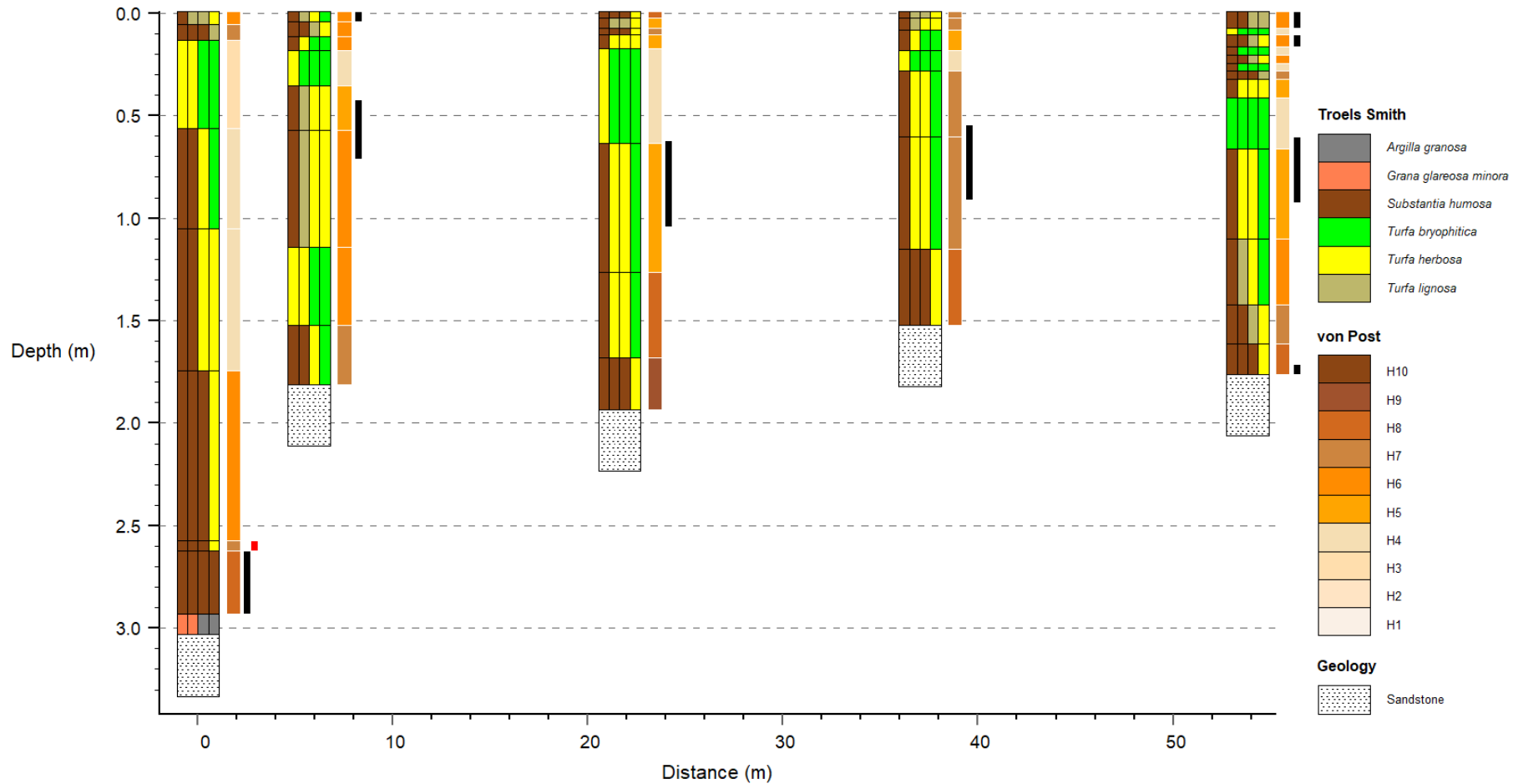


Figure 4. Stratigraphy data displayed against depth using PPSP for cores 15, 76, 83, 78 and master from Transect A at Keighley Moor, Yorkshire, England (Blundell & Holden 2014). Troels-Smith (left-hand column, four rectangles wide), von Post (adjacent graded brown column), charcoal (black rectangles adjacent to von Post column) and large wood remains (red rectangles adjacent to charcoal) are featured.

Keighley Moor transect A (cores 15, 76, 83, 78 and master)

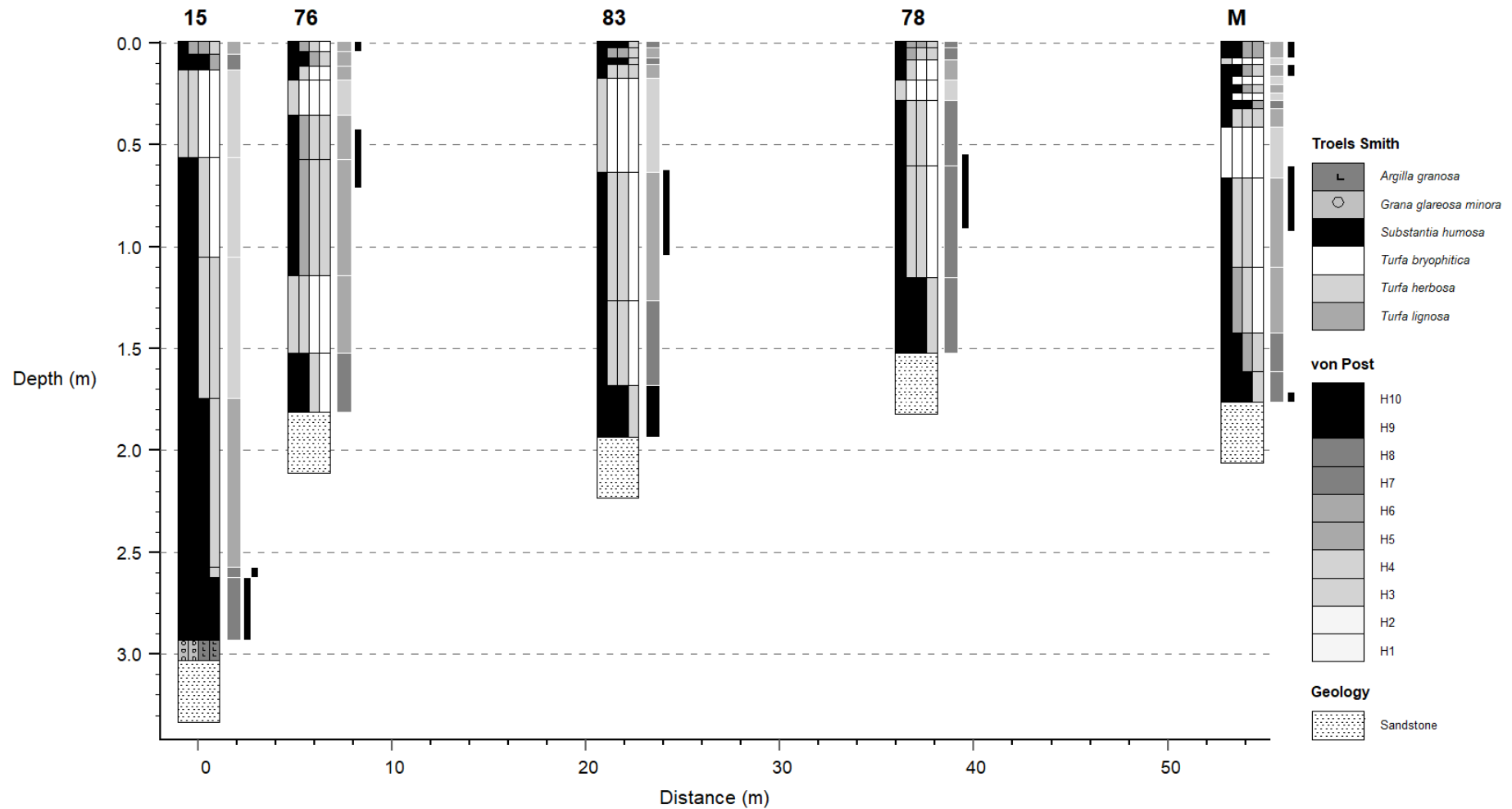


Figure 5. As for Figure 4 but displayed using black and white, shades of grey and limited symbols for mineral elements at the base of 15. This figure also demonstrates the core labelling feature (15, 76, 83, 78 and M). In this case von Post assignments have been grouped (H1–2, H3–4, H5–6, H7–8 and H9–10) in terms of black/grey-shade to aid depiction.

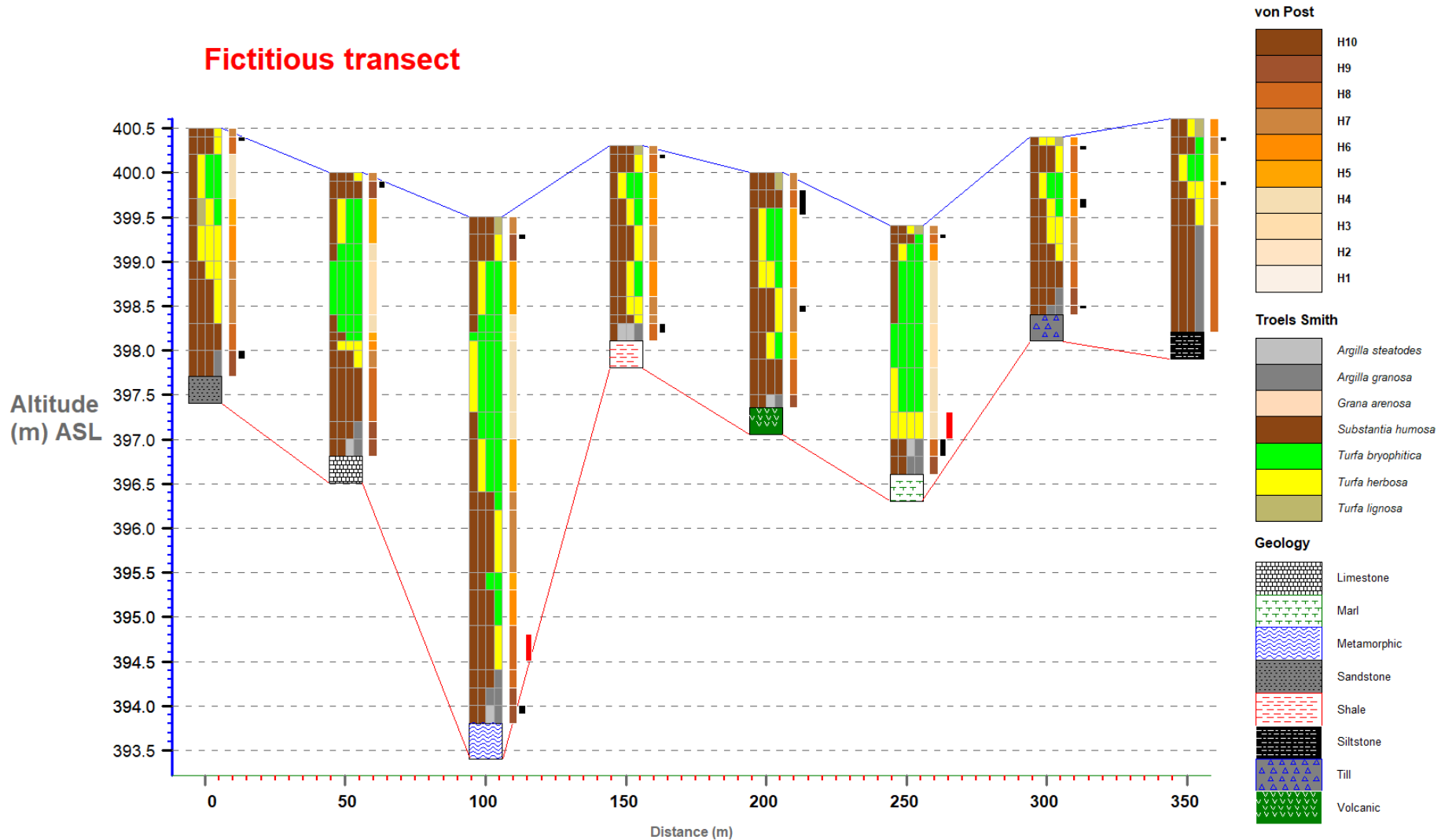


Figure 6. Attempt, using a fictional dataset, to demonstrate much of the aesthetic and plotting potential that PPSP has at present. Troels-Smith (left-hand column, four rectangles wide), von Post (adjacent graded brown column), charcoal (black rectangles adjacent to von Post column) and, in this case, *Phragmites* remains are indicated by red rectangles using the ‘other’ presence/absence function.

STRENGTHS, LIMITATIONS AND AREAS FOR DEVELOPMENT

Strengths

- The approach to plotting allows the detail of Troels-Smith assignments for even short core sections to be displayed. The ability to also plot von Post, charcoal and another presence/absence observations in parallel columns to facilitate simple cross-data and cross-core comparisons makes for a powerful visual tool.
- PPSP is free open-source software, operates across Windows, Linux and MacOS platforms, and the code can be developed within the terms of the General Public Licence v3.0.
- A comprehensive user manual is included. Seven data and parameter files are provided based on real and fictional data so users can quickly construct figures and, by altering parameters, expedite learning and become proficient with the program.
- As with P4 (Blundell 2023), there is no GUI. Using two csv files means that parameters can be copied and pasted quickly from previous projects and then minor edits made, reducing the amount of time spent searching in menus and submenus.
- The program's run time is short with figures completed and saved within seconds meaning fine tuning, often requiring numerous iterations, is not taxing.
- Figures can be produced in three formats (eps, png and jpg), although a screen shot from a large high-resolution monitor produces excellent results.
- There are multiple error capture procedures that check user inputs in parameter and data files. If tripped these provide constructive messages towards identifying the causes of most issues.

The program remains in development and, therefore, further improvements can be made by users themselves or the author.

Limitations and areas for development

- As PPSP primarily uses colours it may not be suitable for cores incorporating an extensive range of Troels-Smith categories. Colour choices are important for clarity and ensuring accessibility. At present a limited choice of symbols that can be used for mineral components can aid with clarity, and further symbols could be produced for other categories in the future.

- It may be argued there are too few geology/basal sediment options (ten at present), but these can be expanded if required by developing more functions.
- PPSP does not display the Troels-Smith boundary sharpness property as TSPPlus once did. This is not particularly relevant or informative, for peatlands at least, but the author recognises that it may be for cores from other habitats such as salt marshes or lakes.

Some users who are unfamiliar with coding may be wary of using the command line, or the thought of working in a virtual environment. Reassuringly, no coding skills are required to operate this program.

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REFERENCES

- Blundell, A. (2023) ANTB25/P4-PYTHON-PALAEO-PLOTTING-PROGRAM: P4 release 1.0.3 (v1.0.2). Zenodo. <https://doi.org/10.5281/zenodo.7544255>
- Blundell, A. (2025) ANTB25/PPSP: PPSP v1.0.2 (v1.0.2). Zenodo. <https://doi.org/10.5281/zenodo.17246507>
- Blundell, A., Holden, J. (2014) Using palaeoecology to support blanket peatland management. *Ecological Indicators*, 49, 110–120.
- Clark, A. (2015) Pillow (PIL Fork) Documentation, readthedocs. Available at: <https://buildmedia.readthedocs.org/media/pdf/pillow/latest/pillow.pdf>.
- Crameri, F., Shephard, G.E. Heron, P.J. (2020) The misuse of colour in science communication. *Nature Communications*, 11, 5444. <https://doi.org/10.1038/s41467-020-191607>
- Harris, C.R., Millman, K.J., van der Walt, S.J., Gommers, R. and 22 others (2020) Array programming with NumPy. *Nature*, 585, 357–362. <https://doi.org/10.1038/s41586-020-2649-2>
- Juggins, S. (2022) rioja: Analysis of Quaternary Science Data. R package version 1.0-5. <https://cran.r-project.org/package=rioja>.
- Nalepka, D., Walanus, A. (2003) Data processing in pollen analysis. *Acta Palaeobotanica*, 43, 125–134.

- The pandas development team (2025) pandas-dev/pandas: Pandas (v2.3.1). Zenodo. <https://doi.org/10.5281/zenodo.15831829>
- Troels-Smith, J. (1955) *Karakterisering af løse jordarter (Characterisation of Unconsolidated Sediments)*. Denmark's Geologiske Undersøgelser Series IV, 3(10), 73 pp. (in Danish).
- von Post, L. (1922) Sveriges geologiska undersöknings torvinventering och några av dess hittills vunna resultat (The Geological Survey of Sweden's peat inventory and some of its results so far). *Svenska Mosskulturföreningens Tidskrift*, 36, 1–27 (in Swedish).
- von Post, L. (1924) Das genetische System der organogenen Bildungen Schwedens (The genetic system of the organogenic formations of Sweden). In: Comité International de Pédologie, IVème commission (commission pour la nomenclature et la classification des sols, commission pour l'Europe, président: B. Frosterus) (ed.) *Mémoires sur la Nomenclature et la Classification des Sols*, Helsingfors/Helsinki, 287–304 (in German).
- Waller, M., Entwistle, J.A., Duller, GAT (1995) 'TSPPlus - a menu driven program for the display of stratigraphic data', *Quaternary Newsletter*, 77, 32–39.

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