[PS]WheelerLab: An Interactive Program for Sequence Stratigraphic Analysis of Seismic Sections and the Generation of Dynamic Chronostratigraphic Sections*

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Abstract

WheelerLab is an interactive program that facilitates the interpretation of seismic data within a sequence stratigraphic framework and the subsequent transformation of the data into the chronostratigraphic domain. The transformation enables the identification of significant geological features, particularly erosional and non-depositional features that are not obvious in the original seismic domain. Although there are some software products that contain interactive environments for carrying out chronostratigraphic analysis, none of them are open-source codes. In addition to being open source, WheelerLab adds two important functionalities not present in currently available software: 1) WheelerLab generates a dynamic chronostratigraphic section and 2) WheelerLab enables chronostratigraphic analysis of older seismic data sets that exist only as images and not in the standard seismic file formats as well as outcrop images and interpreted well sections. The dynamic chronostratigraphic section sequentially depicts the evolution of the chronostratigraphic chronosomes concurrently with the evolution of identified genetic stratal packages. This facilitates a better communication of the sequence-stratigraphic process. WheelerLab is designed to give the user both interactive and interpretational control over the transformation; this is most useful when determining the correct stratigraphic order for laterally separated genetic stratal packages. The program can also be used to generate synthetic sequence stratigraphic sections for chronostratigraphic analysis.

References Cited

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Introduction and Objective

WheelerLab is an interactive program that facilitates the interpretation of stratigraphic data (seismic sections, outcrop data and well sections) within a sequence stratigraphic framework and the subsequent transformation of the data into the chronostratigraphic domain.

The transformation enables the identification of significant geological features, particularly erosional and non-depositional features that are not obvious in the original seismic domain.
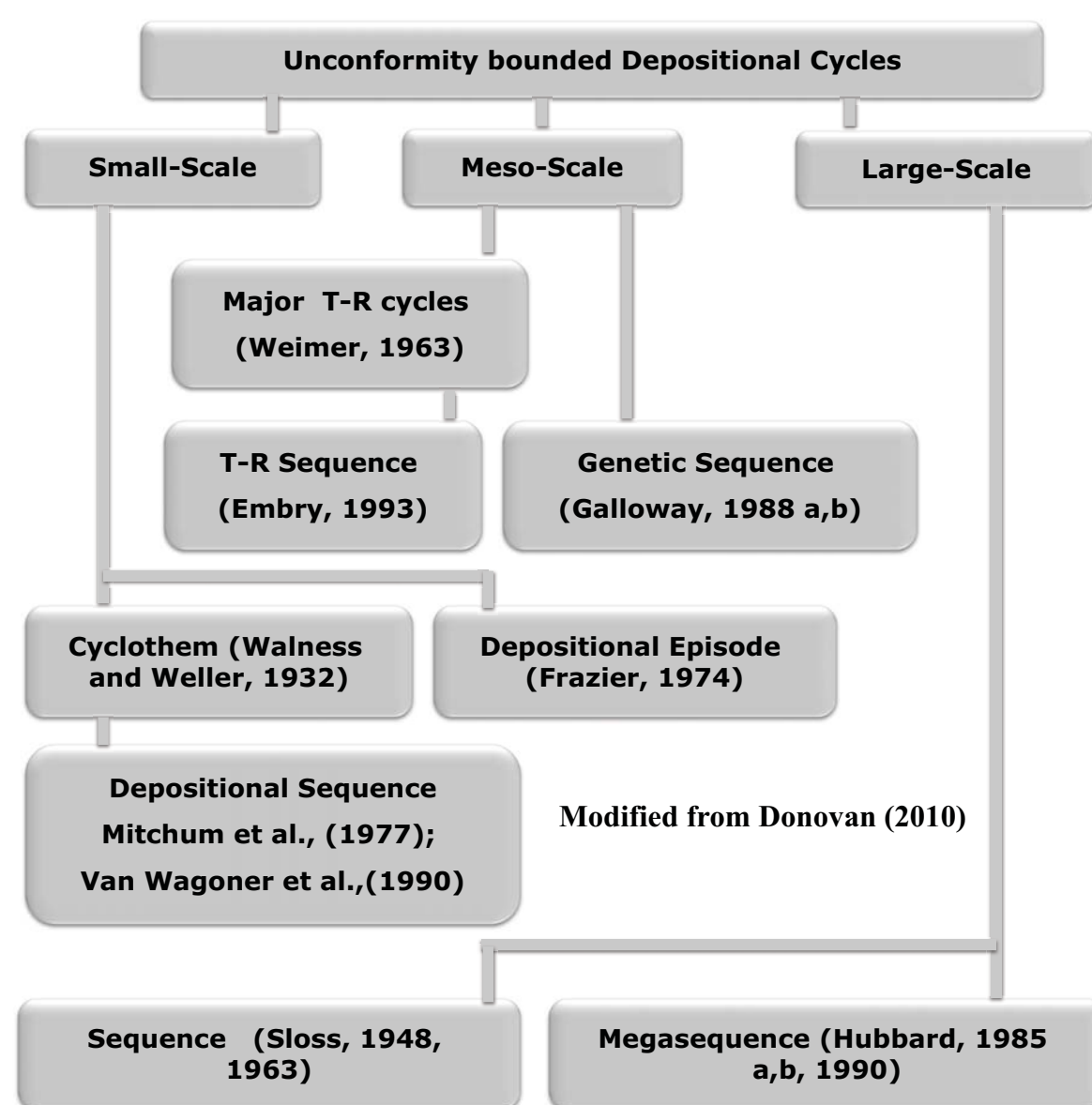
Theory of Sequence Stratigraphy

Fig. 1 Sequence stratigraphy family tree of frameworks categorized by temporal and spatial scale.

- *Sequence Stratigraphy is a template for the analysis of sedimentary deposits with a focus on the patterns resulting from the variations in accommodation (space available for potential sediment accumulation) and sedimentation and the temporal order in which genetically related (laterally continuous) sedimentary strata are deposited.*

- *Within this template (which consists of several frameworks), major time significant surfaces enclose successions of strata to define sequences. The sequences are made up of systems tracts, which can be identified from their geometry, stratal terminations and characteristic stacking patterns.*

- *The stratal geometry, stacking patterns and facies heterogeneity of the sedimentary deposits are thus highlighted within a chronostratigraphic framework. The most commonly observed system tracts are the highstand systems tract (HST), the falling stage systems tract (FSST), the lowstand systems tract (LST) and the transgressive systems tract (TST).*

Code Usage and Description

- *WheelerLab is written in Matlab (2016b) and has a graphical user interface (GUI). The program operates in two modes: The "Layer" mode and the "Surface" mode. In the "Layer" mode, WheelerLab can be used to draw layers or shapes around sequence tracts. In the "Surface" mode, WheelerLab is used to draw surfaces or lines for interpretational purposes. Flattened chronosomes, are constructed using simple logical conditions to determine the horizontal extent of each chronosome and interactive user input to determine the vertical depositional order in relative geological time.*

- *For each layer the user may select from a list of common sequence stratigraphic classifications or create a new classification. The layers will be displayed with distinct colors along with an image containing movable lines matching the colors of the layers. The user may rearrange the lines in the correct chronostratigraphic order with the youngest layer at the top and the oldest layer at the bottom. The interpreted sequence stratigraphic section and the chronostratigraphic section are saved in Portable Network Graphics and MATLAB FIG formats while the dynamic chronostratigraphic section is saved in Graphics Interchange Format and Audio Video Interleve formats.*

- *A video demonstrating the usage of the program is included in the supplementary section (see download link below).*
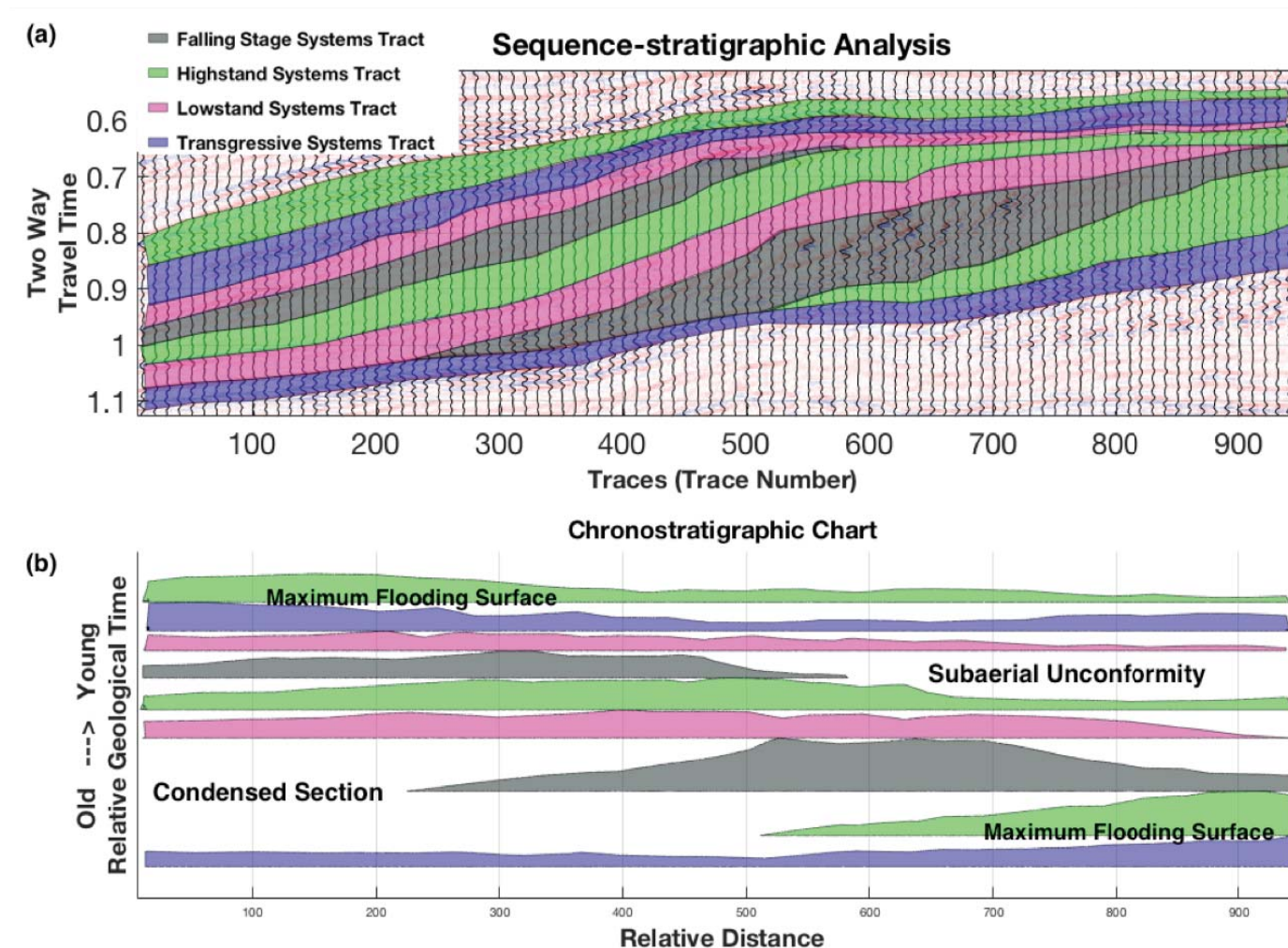

Fig.3 (a) Sequence stratigraphic interpretation of a seismic section and (b) the corresponding chronostratigraphic chart created using WheelerLab. The data is from block F3 of the northern part of the Netherlands North Sea sector.
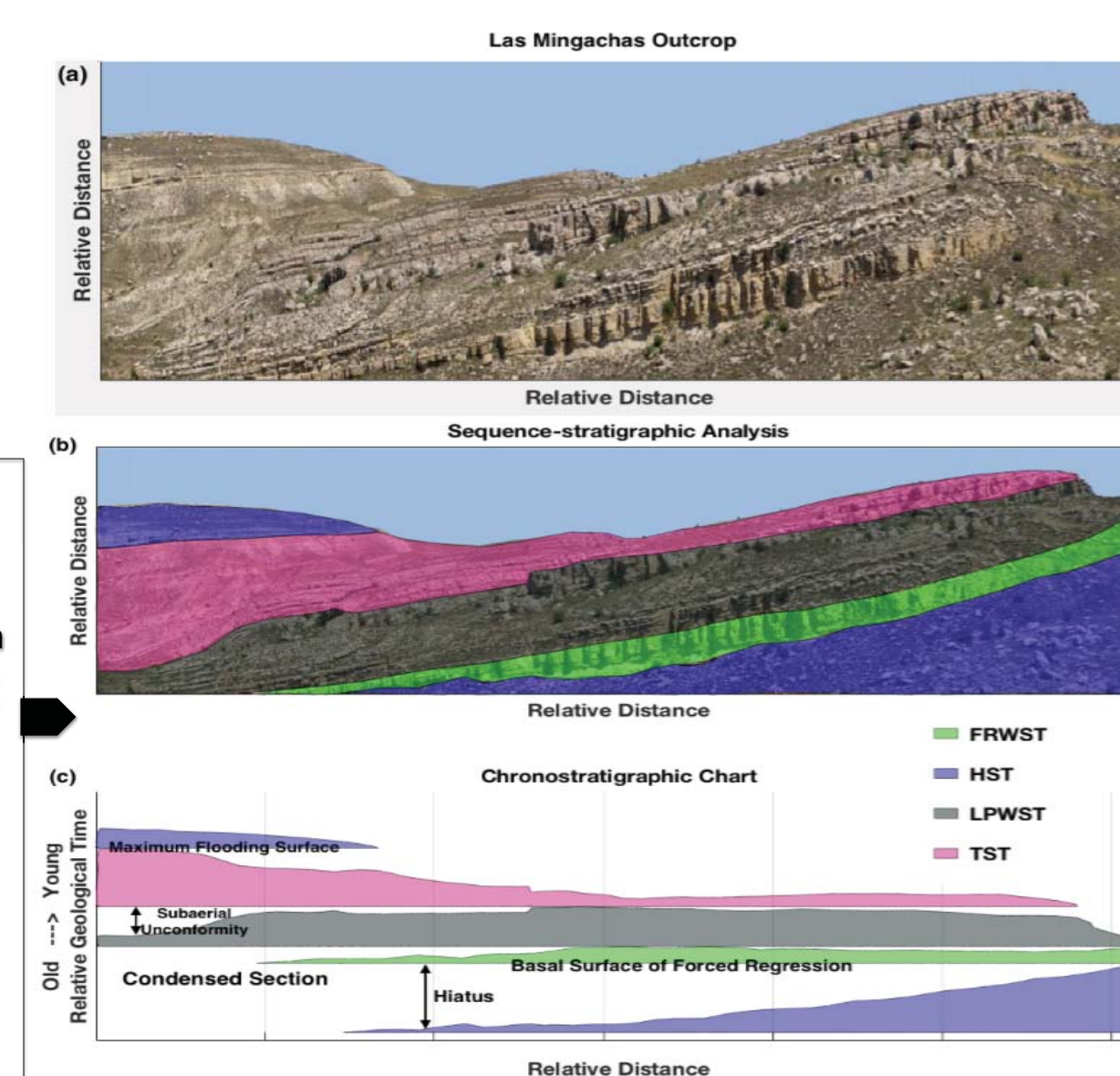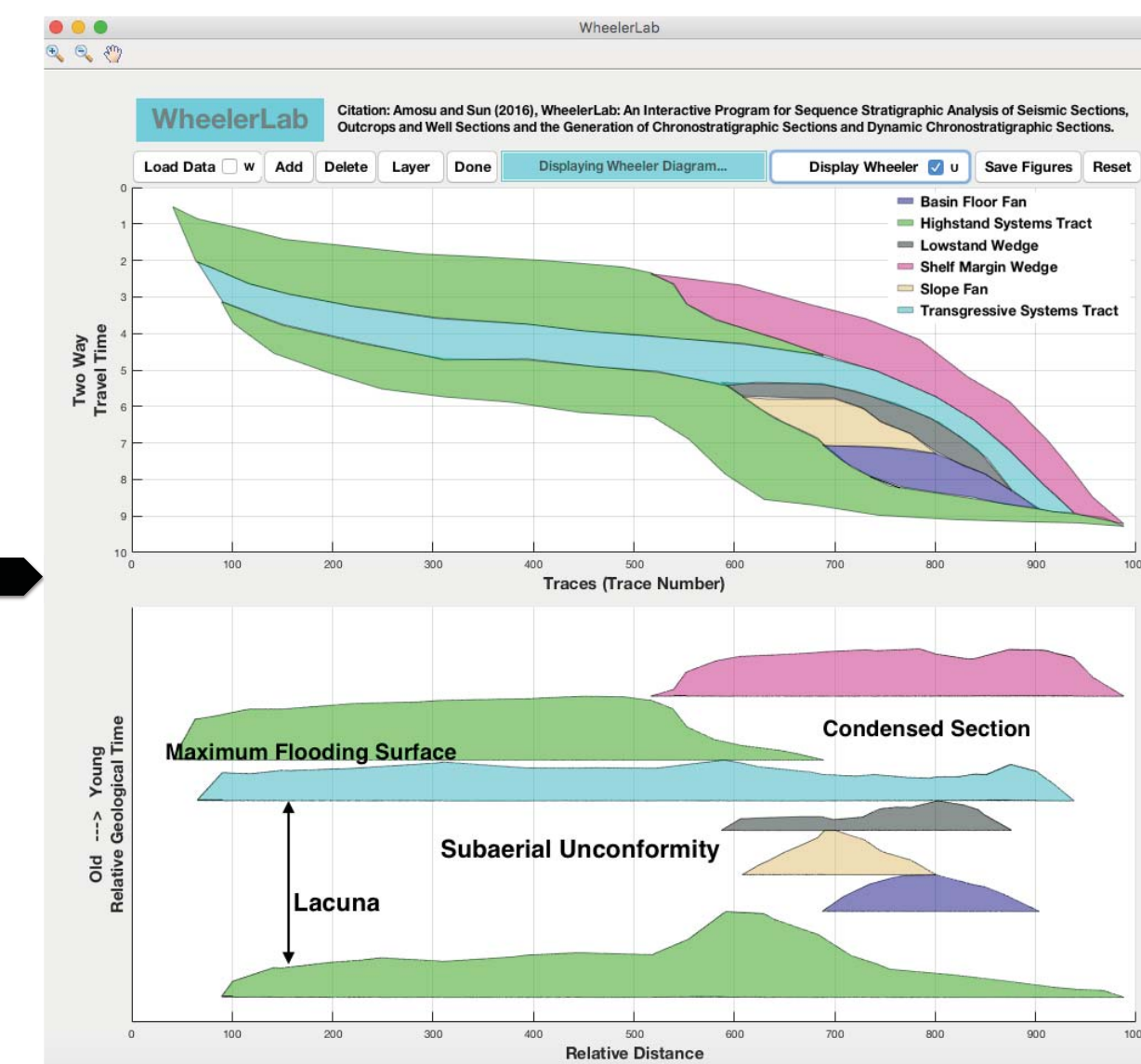
Fig.4 (a) Photograph of the southern part of Las Mingachas outcrop, (b) Sequence stratigraphic interpretation of the outcrop and (c) corresponding chronostratigraphic chart. FRWST=Forced Regressive Wedge Systems Tract; HST=Highstand Systems Tract; LPWST=Lowstand Prograding Wedge Systems Tract; TST=Transgressive Systems Tract. Modified from Bover-Arnal et al.

Applications

Fig. 2 shows the WheelerLab graphical user interface (GUI). Inset images show a synthetic sequence stratigraphic cross-section of a basin with a shelf slope break and its corresponding Wheeler diagram in the top and bottom axes respectively (Using the depositional sequence framework). The subaerial unconformity and condensed section are denoted by gaps in the chronostratigraphic section.

Conclusion

- This paper and program introduce a new concept for interpreting sequence stratigraphic sections called the dynamic chronostratigraphic section. The dynamic chronostratigraphic section shows the sequential evolution of the chronostratigraphic chronosomes concurrently with the evolution of the genetic stratal packages.
- The software is ideal for creating synthetic sequence stratigraphic cross-sections and for interpreting older seismic data (that may exist only as images), outcrop images and interpreted well sections and the subsequent generation of chronostratigraphic sections and dynamic chronostratigraphic sections in relative geological time and relative distance units .

DOWNLOAD LINK: https://goo.gl/5gtZqz **QR CODE:** **USAGE QUESTIONS:** adewale@tamu.edu

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