Acta Geologica Sinica (English Edition), 2019, 93(supp.1): 37–39

An Exploration of Building a Thematic Sub-database within the Framework of DDE: A New Detrital Zircon U-Pb Dating Database

LI Chao[1], LAI Wen[1], HU Xiumian[1,*], XU Yajun[2], YANG Jianghai[2] and the DDE Sedimentary Data Group

[1] *Nanjing University, Nanjing 210023, Jiangsu, China*
[2] *China University of Geosciences (Wuhan), Wuhan 430074, Hubei, China*

Citation: Li et al., 2019. An Exploration of Building a Thematic Sub-database within the Framework of DDE: A New Detrital Zircon U-Pb Dating Database. *Acta Geologica Sinica* (English Edition). 93(supp. 1): 37-39

Within the framework of the Deep-time Digital Earth (DDE) project, thematic databases driven by scientific issues will have strong scientific vitality. In the field of sedimentology, thematic databases based on the current unified sedimentary knowledge tree established by the Sedimentary Data Group (Fig. 1), can solve specific scientific problems effectively and improve the scope and utility of the DDE platform significantly.

The Sedimentary Data Group selected the detrital zircon U-Pb dating database to explore the construction of a thematic database within the DDE framework. Detrital zircons are one of the most common heavy minerals in clastic sedimentary systems with the ability to provide a wide range of information types. For this reason detrital zircon geochronology is rapidly developing into an essential tool in earth-science research (Gehrels, 2014).

Thousands of detrital zircon U-Pb ages have been published during the past two decades (Puetz et al., 2018). After constructing of a global zircon database, we can provide key information for earth system evolution, continental convergence, etc. For example, Cawood et al. (2013) found that global detrital zircon age peaks are similar with the ages of supercontinents. More recently, McKenzie et al. (2016) argued that continental arc volcanism is the principal driver of icehouse-greenhouse variability based on compilation of ~120,000 detrital zircon ages from global sedimentary deposits as a proxy to track the spatial distribution of continental magmatic arc systems from the Cryogenianto the present.

Internationally, detrital zircon databases are not uncommon. Global U-Pb Database 2017 is the largest published zircon age database, but there are only 22,262 of 186,066 detrital zircon ages from China (Puetz et al., 2018). For the Tibetan Plateau alone, 53,587 U-Pb ages from 86 references have been collected by the Sedimentary Data Group. This suggests there should be many thousands of detrital zircon ages that are not included in published global U-Pb ages databases. Therefore, a more detailed and accurate database of detrital zircon U-Pb ages is available and is needed for earth-science research in the modern era of big data.

Detrital zircon U-Pb ages are also essential for improving the

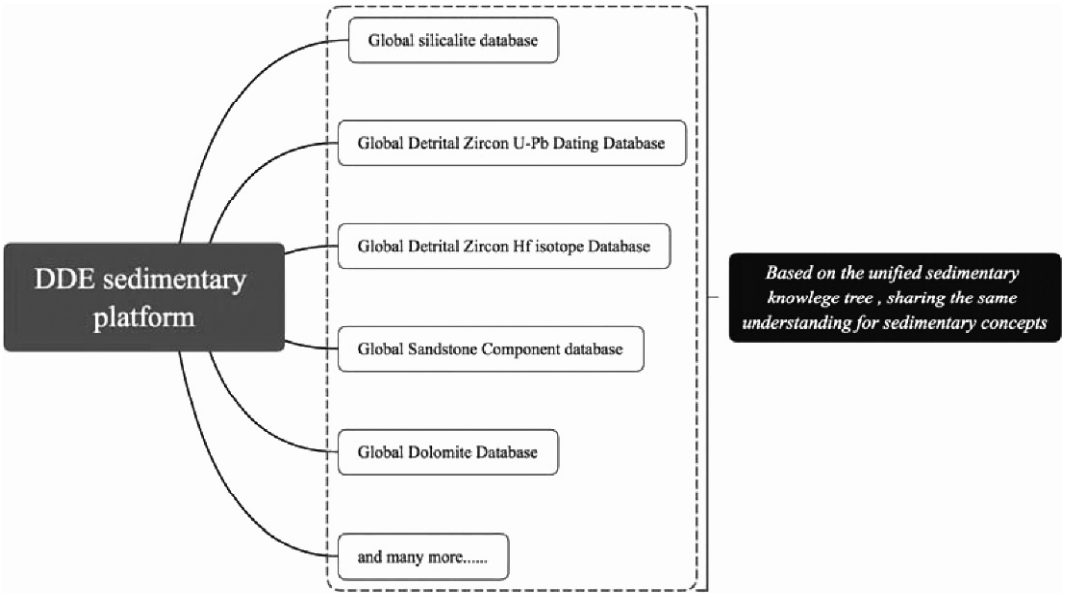

Fig. 1. Relationships between DDE sedimentary platform and thematic databases.

* Corresponding author. E-mail: huxm@nju.edu.cn

reconstruction of global paleogeography because these ages can be used to constrain the maximum sedimentary age of the host sediment, reconstruct palaeodrainage pattern and provenance, and characterize many different aspects of source regions (Gehrels, 2014). Thus, the association of detailed metadata (e.g., source tectonic unit, source lithostratigraphic unit) with detrital zircon ages is also essential.

In order to assemble the thematic database of detrital zircon U-Pb ages, we took the following steps:

1) Assess the scientific questions or needs of scientists.

China and East Asia have complex geological backgrounds. Many geological units (e.g., the North China Block, Yangtze Block, Lhasa terrane, Qiangtang terrane) have extremely complex evolutionary histories. Terrane collision and crustal accretion events occurred frequently. The collection of dense detrital zircon U-Pb age data in space and time can help geologists mine more information relevant to understanding the geological evolution of our planet.

2) Build the thematic data structure based on the unified sedimentary knowledge tree.

Contents of sedimentology across all thematic databases should follow the established DDE sedimentary knowledge tree.

Establishment of a reasonable database structure is critical to efficiently storage, recall and analysis of the thematic data. In the new detrital zircon database, we designated samples as the core of the database. Each sample was given a unique ID, which reflects important information such as the data source and tectonic location. The logic of database design is to record details of the sample, including location, lithology, rock units, and grain ages (Fig. 2).

3) Choose the right work platform, and data-entry mode.

To build the DDE detrital zircon U-Pb dating database, we chose Microsoft Access™ as the database platform because of its simple data structure. Higher-level database platforms are recommended when the data structure is complex.

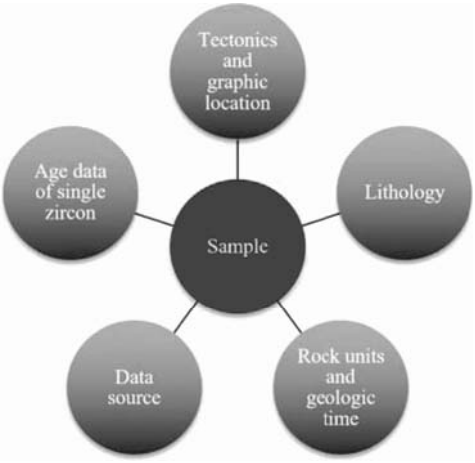

Fig. 2. Design logic of the new database.

According to the design logic, three tables were generated which form the new database. The Reference Table records reference ID, first author, year of publication and citation format. The Sample Table records the sample ID, data source ID, tectonic and graphic locations, lithology, testing minerals, testing method and laboratory. The Grain Age Table records sample ID, best ages, errors and other original isotopic results (Fig.3). These tables are connected by Sample ID and Reference ID.

In order to accelerate construction of the DDE database we designed a Microsoft Excel™ template which has a similar structure to the Access database. The keyboarder only needs to split the original data into the Excel template, so that the data can be conveniently importedinto the database.

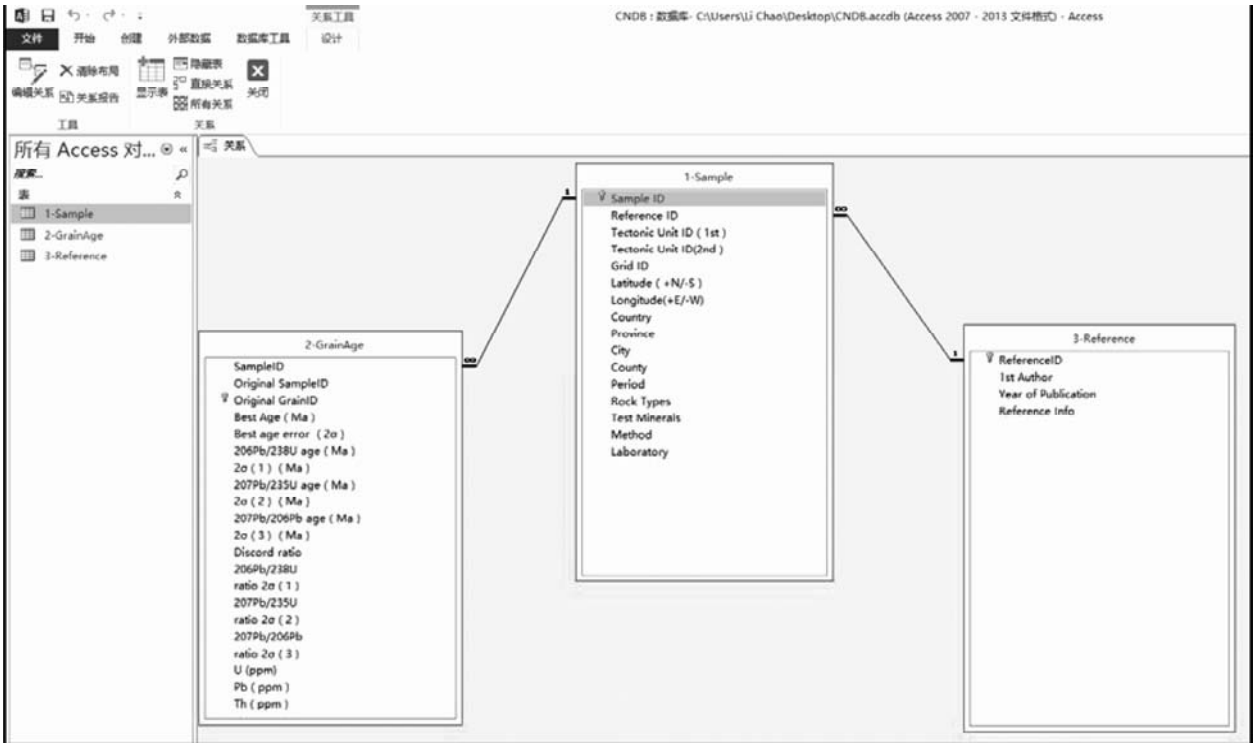

Fig. 3. Tables and relationships of the new database.
The middle table is sample table. The left table is grain age table. The right table is reference table.

After construction of the DDE framework and the technical support center is completed, scientists only need to complete the first two steps of the process outlined above: to raise scientific questions and complete the data structure design. Database platform construction, along with the collection and entry of data, will be supported by the technical support center. This will improve the efficiency of the DDE platform significantly.

Keywords: DDE platform, thematic database, sedimentary knowledge tree, Sedimentary Data Group

Acknowledgements: Thanks to the DDE program for support, thanks to the members in DDE Sedimentary Data Group for their excellent work.

References

Cawood, P.A., Hawkesworth, C., and Dhuime, B., 2013. The continental record and the generation of continental crust. *Geological Society of America Bulletin*, 125(1-2): 14–32.

Gehrels, G., 2014. Detrital Zircon U-Pb Geochronology Applied to Tectonics. *The Annual Review of Earth and Planetary Sciences*, 42: 127–149. doi: 10.1146/annurev-earth-050212-124012.

McKenzie, N.R., Horton, B.K., Loomis, S.E., Stockli, D.F., Planavsky, N.J., and Lee, C.T.A., 2016. Continental arc volcanism as the principal driver of icehouse-greenhouse variability. *Science*, 352(6284): 444–447.

Puetz, S.J., Ganade, C.E., Zimmermann, U., and Borchardt, G., 2018. Statistical analyses of Global U-Pb Database 2017. *Geoscience Frontiers*, 9(1): 121–145. doi: 10.1016/j.gsf.2017.06.001.

About the first author

LI Chao, male, born in 1990 in Baoding City, Hebei Province; Master; graduated from Chengdu University of Technology; Ph.D student in Nanjing University. He is now interested in the South China Block tectonics and big data analysis in Sedimentology. Email: lichaogeo@icloud.com; phone: 025-89680703.

About the corresponding author

HU Xiumian, male, born in 1974 in Nanchang City, Jiangxi Province; PhD; graduated from Chengdu University of Technology; Professor in Nanjing University. He is now interested in the study of sedimentary, tectonic and palaeoenvironmental evolution of the eastern Tethys ocean. Email: huxm@nju.edu.cn; phone: 025-89683002.