COMMENT

Yi-Ming Gong, Hong-Fu Yin, Ke-Xin Zhang, Yuan-Sheng Du, Qing-Lai Feng, Xu-Long Lai, Shu-Cheng Xie, Jin-Nan Tong, Song-Zhu Gu
Faculty of Earth Science, China University of Geosciences, Wuhan 430074, China
Xiao-Ying Shi
Faculty of Earth Science and Resources, China University of Geosciences, Beijing 100083, China
Elizabeth A. Weldon, Guang R. Shi
School of Ecology and Environment, Deakin University, Melbourne Campus, 221 Burwood Highway, Burwood, Victoria 3125, Australia
Xue-Ping Ma
Department of Geology, Peking University, Beijing 100871, China

Zalasiewicz et al. (2004) propose that it is time to end the distinction between the dual stratigraphic terminology of chronostratigraphy and geochronology. Their proposal is based on observations that: (1) it is difficult for the greater part of the professional geological community to distinguish between chronostratigraphy and geochronology; (2) stratigraphic concepts, dating methods, and practices used on stratified rocks are supplemented by techniques such as magnetostratigraphy and radiometric dating, which can be used on nonstratified rocks; (3) stratigraphic principles are now used to map Earth, the Moon, and other solid planets; and (4) that boundary stratotypes or global stratotype section and points (GSSPs) are widely used in defining formal geological time units. We consider the proposal of Zalasiewicz et al. (2004) to be timely, constructive, and significant for the further development and enhancement of stratigraphy. We also believe that the proposal of Zalasiewicz et al. (2004) needs some further clarification and perfection.

We agree that ending the distinction between the parallel units of chronostratigraphy and geochronology will not only simplify stratigraphic practice for use by the wider geologic community, it will also, we believe, provide an opportunity to extend the geochronological terminology to the commonly used anthropological time scale (millennium, century, etc.). With the development of geosciences and related science and technology, it is recommended that geologic-time units should not only have the eon, era, period, epoch, age, and chron, which are well known, but should also be extended to include shorter-term time units such as eccentricity year, obliquity year, precession year, millennium, century, year, and so on (see Bai, 1995; House, 1995; Gong and Li, 1999; Hinnov, 2000; Gong et al., 2001).

It is well known that formally defined geologic-time units and their boundaries are exclusively anchored in classical strata by global stratotype sections and points (GSSPs) (e.g., Yin et al., 2001) and by numerical dating methods (e.g., Bowring et al., 1998). Together the GSSPs and geochronology are designed to maintain precision and stability of geologic-time units. These geologic-time units can be used to study the time recorded in both classical strata and other geologic bodies and establish a high-resolution geologic-time scale based on a single set of stratigraphic terms.

Compared with chronostratigraphic units (eonothem, erathem, system, series, stage, chronozone) that, by definition, exclude nonstratified rocks (Hedberg, 1976), geologic time units (eon, era, period, epoch, age, chron, etc.) can be used to encompass both stratified and nonstratified rocks. For example, the term Late Devonian epoch not only contains all sedimentary strata laid down during the Late Devonian epoch, but also comprises the processes and products of magmatic, metamorphic, tectonic, and other geologic events that have taken place during that epoch. This example also shows how the simplification of the terminology used will allow greater flexibility and integration of stratigraphic disciplines, which in turn would greatly extend the applications of stratigraphic theories.

We are in favor of the idea of being able to refer to both stratified and nonstratified rocks on the one time scale. In conducting our stratigraphic research and geologic mapping in some orogenic belts of China, we have found that the classical paradigm of stratigraphy based on William Smith's original concept (which we call Smith stratigraphy) is not suitable for orogenic belts. In structurally complicated geological settings such as fold belts and suture zones, typically there are both stratified and nonstratified rocks. In dealing with these cases it has been our practice to use a number of different stratigraphic techniques including: Smith stratigraphy, non–Smith stratigraphy, and numerical dating methods (e.g., Gong et al., 1996; Yin et al., 1999; Zhang et al., 2000). Zalasiewicz et al.'s (2004) proposed chronostratigraphy will allow us to report field mapping results from both the stratified and nonstratified rocks in orogenic belts on the one time scale.

In summary, we support the proposal of Zalasiewicz et al. (2004) to terminate the distinction between the dual stratigraphic terminology applied to chronostratigraphy and geochronology. A unified (integrated) chronostratigraphic-geochronologic scale will allow both stratified, nonstratified rocks, and geological processes to be referred to together on the one time scale, and it also has the potential to extend current stratigraphic theories and techniques to a wider range of geological applications (e.g., mapping in orogenic belts). In addition, we would like to suggest that the unified chronostratigraphic-geochronologic scale be extended into, and combined with, anthropological time units such as millennium, century, year, etc.

REFERENCES CITED

Bai, S.L., 1995, Milankovitch cyclicity and time scale of the Middle and Upper Devonian: International Geological Review, v. 37, p. 1109–1114.

Bowring, S.A., Erwin, D.H., Jin, Y.G., Martin, M.W., Davidek, K., and Wang, W., 1998, U/Pb zircon geochronology and tempo of the end-Permian mass extinction: Science, v. 280, p. 1039–1045, doi: 10.1126/SCIENCE.280.5366.1039.

Gong, Y.M., and Li, B.H., 1999, High resolution stratigraphy, Milankovitch cycle and ENSO event deposits: Geological Science and Technology Information, v. 18, p. 32–36.

Gong, Y.M., Du, Y.S., Feng, Q.L., Yan, J.X., and Liu, B.P., 1996, Thinking about non-Smith stratigraphy: Earth Science, v. 21, p. 19–26.

Gong, Y.M., Li, B.H., Wang, C.Y., and Wu, Y., 2001, Orbital cyclostratigraphy of the Devonian Frasnian-Famennian transition in South China: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 168, no. 3–4, p. 237–248, doi: 10.1016/S0031-0182(00)00257-1.

Hedberg, H.D., 1976, International stratigraphic guide: New York, John Wiley, 200 p.

Hinnov, L.A., 2000, New perspectives on orbitally forced stratigraphy: Annual Review of Earth and Planetary Sciences, v. 28, p. 419–475, doi: 10.1146/ANNUREV.EARTH.28.1.419.

House, M.R., 1995, Orbital forcing timescales: An introduction, *in* House, M.R., and Gale, A.S., eds., Orbital forcing timescales and cyclostratigraphy: Brassmill, Geological Society [London] Special Publication 85, p. 1–18.

Yin, H.F., Zhang, H.T., Qihe, R., Yu, Q.W., Zhang, K.X., Ren, J.Q., and Gu, F.B., 1999, Discussion on non-Smith stratigraphy: Chinese Geology, v. 265, p. 24–29 (in Chinese).

Yin, H.F., Zhang, K.X., Tong, J.N., Yang, Z.Y., and Wu, S.B., 2001, The global stratotype section and point (GSSP) of the Permian-Triassic boundary: Episodes, v. 24, no. 2, p. 102–114.

Zalasiewicz, J., Smith, A., Brenchley, P., Evans, J., Knox, R., Riley, N., Gale, A., Gregory, F.J., Rushton, A., Gibbard, P., Hesselbo, S., Marshall, J., Oates, M., Rawson, P., and Trewin, N., 2004, Simplifying the stratigraphy of time: Geology, v. 32, no. 1, p. 1–4, doi: 10.1130/G19920.1.

Zhang, K.X., Huang, J.C., Yin, H.F., Wang, G.C., Wang, Y.B., Feng, Q.L., and Tian, J., 2000, Application of radiolarians and other fossils in non-Smith strata—Exemplified by the Anyemaqen mélange belt in East Kunlun Mts: Science in China, v. 43, p. 364–374.

COMMENT

Michael G. Bassett*
John C.W. Cope
Department of Geology, National Museum of Wales, Cardiff CFl0 3NP, UK
Jake M. Hancock†
Bleke House, Shaftesbury, Dorset SP7 8QA, UK
Charles H. Holland
Department of Geology, Trinity College, Dublin 2, Ireland

*E-mail: Mike.Bassett@nmgw.ac.uk
†After a short illness, Jake Hancock died on 4 March 2004. This leading thinker on stratigraphic principles agreed to a late draft of this response and wished to be associated with it.