



May 1, 2007

Dear Colleagues,

The discussions and comments circulated to this point are far from bringing the “debate” to a satisfactory conclusion. However, as the deadline for commenting on the ISSC report on sequence stratigraphy is approaching, I wish to offer some final thoughts.

### **Is there really a “debate” on sequence stratigraphy?**

For the last month or so, I have watched with interest the developments of Ashton Embry’s war against the stratigraphic world. Ashton likes to call this “The Great Debate”, as published in his recent letter in the May issue of CSPG Reservoir. That implies that a “debate” exists, and furthermore, that it is “great”. I doubt there is validity in either of these keywords. This was a one-sided affair from day one.

A constructive debate implies that the parties involved in the discussion have a genuine interest in working together towards a consensus. This exercise should be all about finding the common ground that defines the foundation of sequence stratigraphy. There is no doubt that common ground exists; otherwise sequence stratigraphy would not work as a method of stratigraphic analysis. We all know there are different approaches to sequence stratigraphy, and that none of them is foolproof under all circumstances. Therefore, trying to impose a single model that is supposed to provide an ultimate, universal template is bound to fail. Egos must be left behind, and any stratigrapher who has been exposed to data sets from a sufficiently large number of sedimentary basins would agree that the applicability of the sequence stratigraphic method varies at least with: 1. tectonic setting; 2. the data set that is available for analysis; 3. depositional setting; and 4. scale of observation.

There is a clear trend that defines the character of this “debate”: without exception, every renowned stratigrapher who took the time to comment expressed serious reservations about the ISSC report on sequence stratigraphy – or, to represent facts more accurately, Ashton Embry’s report on sequence stratigraphy. Invariably, Ashton is rejecting everyone’s comments, and pushes forward his own style of sequence stratigraphy. This style of sequence stratigraphy (known as the T-R model) is only used by a minority of practitioners, generally people who do not have access to seismic data. As other people have noted (see the debate window where comments are posted), Ashton is not interested in a consensus, but rather in having his own views validated by the ISSC as the only “scientifically valid” approach to sequence stratigraphy. This is not a debate; it is one man’s effort to prove everybody else wrong.

### **Science**

Is it possible that all people who expressed fundamental concerns about Ashton’s views and science are wrong and Ashton is right? This is most unlikely, and evident from the previous comments posted on this website regarding the scientific shortcomings of the ISSC report. One

reason for the occurrence of scientific flaws in the ISSC report is the fact that the report is heavily based on conference proceedings that have never been subject to peer review.

Stratal terminations (lapouts) are totally ignored in the ISSC report, even though they are essential for defining stratal stacking patterns and sequence stratigraphic surfaces. As various people explained, core and outcrop data are often sparse, and seismic data offer a clear advantage under many circumstances, within both mature and frontier basins. Importantly, seismic data afford the observation of stratal terminations, changes in stratal stacking patterns along 2D lines, and the 3D visualization of surfaces and depositional elements in the subsurface. This is not to say that any type of data is more important than others, as ultimately it is their *integration*, wherever possible, which offers the key to the most reliable sequence stratigraphic framework.

A major point in my comments dated March 7<sup>th</sup> is that sequence stratigraphy is different from lithostratigraphy and other types of stratigraphy that are exclusively based on the study of rocks themselves (in outcrop or core), and it is unique in its objective of analyzing stratal stacking patterns and changes thereof within a time framework. The recognition of some of these changes in stratal stacking patterns requires the study of stratal terminations (e.g., offlap, onlap, downlap), which are best observed on seismic lines. The exclusive usage of outcrop and core data, while maybe a traditional practice within the ISSC in relation to other types of stratigraphy, provides an incomplete picture of the entire sequence stratigraphic framework. The ISSC procedures need to adjust accordingly to the uniqueness of sequence stratigraphy.

The ISSC task group on sequence stratigraphy rejects the objectivity, or usefulness of seismic data in sequence stratigraphic analysis, even though such data are currently used by the majority of practitioners in this field of stratigraphic research. The main reason for this rejection is the limitation imposed by vertical seismic resolution. This is all relative to the scale of investigation and to the purpose of each particular case study. In petroleum exploration, the limitation imposed by vertical seismic resolution becomes trivial. Correlative conformities are mappable based on observable changes in stratal stacking patterns, within the 'X-meter' interval of vertical seismic resolution. Vertical resolution has improved dramatically within the past decades, from tens of meters to meters, and it will continue to improve. When we talk about error margins plus or minus a few meters, outcrop and core data are equally vulnerable.

The analysis of any type of data involves some degree of interpretation. The error margin of interpreting sequence stratigraphic surfaces in outcrop can be on par with vertical seismic resolution. For example, try to pinpoint a maximum flooding surface within a condensed section of meters or tens of meters of shale. The exclusive usage of grain size for the identification of maximum flooding and maximum regressive surfaces is simplistic, and may involve a significant error margin. In a deltaic setting, autocyclic shifting of prograding lobes may cause the top-of-coarsening-upward surface (*interpreted* as the 'MRS') to be in fact a 'within-trend' and diachronous facies contact, older than the end of regression. The diachroneity of the MRS is postulated in the ISSC report to be "low" (qualitative statement), while quantitative modeling and ammonite data demonstrate that such diachroneity can easily be within the biostratigraphic resolution along strike-oriented sections. Such surfaces, or facies contacts, may be less than useful for building a chronostratigraphic framework, which defeats a basic objective of sequence stratigraphy.

The approach taken by the ISSC to classify sequence stratigraphic ‘schools’ into model- versus data-driven, or actualistic versus non-actualistic, is also misleading and erroneous, and hence, offensive to many people. We may all be considered as data-driven and model-driven at the same time. We are all data-driven because we all base our models on data. At the same time, our interpretations rely on facies *models*, so from that perspective we are all model-driven to some extent. For example, the *interpretation* of a maximum regressive surface at the top of a coarsening-upward succession in shallow-water strata is based on a *facies model* of coastal progradation, which has its own limitations, as explained above. Therefore, the ‘empirical’ approach of observing grain-size changes in outcrop does not provide the ultimate answer for the best practice in sequence stratigraphy. At the end of the day it still comes down to the integration of multiple and independent data sets, of which seismic forms an essential component.

Many people have offered comments during this “debate”, with an overwhelming voice against the publication of the ISSC report. Some comments have been posted on this website, some people preferred to offer comments in private and stay out of the public domain. Among these comments, many focused on the topic of data and objectivity in sequence stratigraphic interpretations. As pointed out by a contributor to this discussion, there is no such thing as pure ‘observation’ in geology. All observations carry with them some form of interpretation, otherwise they are essentially meaningless. This is true for the interpretation of any kind of data, from outcrop to seismic. Not all types of data afford the recognition of all types of sequence stratigraphic surfaces, and not all types of sequence stratigraphic surfaces are present in every case study. This is where flexibility becomes the greatest asset of a sequence stratigraphic interpreter. This is also the reason why all models need to be understood and applied when they provide the optimum approach for each particular case study. And this is why we cannot limit ourselves to the standardization of a single model of sequence stratigraphic analysis. The approach to standardization requires a completely different philosophy that focuses on common ground rather than the adoption of a template and the rejection of all other approaches.

In spite of all these facts, and feedback from virtually every contributor to the discussion, Ashton Embry continues to go ahead with his rigid classification of approaches and people into “model-driven” (“deductive”, or “theoretical”) versus “data-driven” (“inductive”, or “empirical”), failing to see the obvious fact that *all ideas have developed from the study of data*.

## Conclusions

Many people have pointed out the biased nature of the ISSC task group, and others went further to explain what the conceptual and practical limitations of the T-R model are. We need a task group that is genuinely interested in finding the common ground and a consensus between various “schools”. To validate the T-R model as the only “scientifically valid” approach would be an error of gigantic proportions – I cannot even think of another publication since the birth of sequence stratigraphy that would be equally unjust to the stratigraphic community at large, and to the purpose for which this ISSC task group was formed in the first place.

Ashton rejected feedback from the best in the world, and stated repeatedly that this feedback is “minor” or even irrelevant, thus not necessitating changes to the ISSC report, and that the opinions of others are “irresponsible” and “non-negotiable”. Ashton is an intelligent and experienced person, but he is also strongly biased and clearly not fit to moderate and lead the effort of standardizing sequence stratigraphy in the International Stratigraphic Guide. I can only



conclude that the publication of this report is unwarranted, would irritate the majority of sequence stratigraphers, and would do a great disservice to the stratigraphic community. There is obvious will in the stratigraphic community to work towards a consensus, but this can only be achieved under the leadership of a more flexible person, who is actually willing to listen to what other people have to say. A new task group must be formed in the future, through a process that involves feedback and participation from all groups in the sequence stratigraphic community.

Best regards,  
Octavian