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# LETTER TO THE EDITOR

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In the recent GeoArabia, Haq and Al-Qahtani (2005) updated the chronostratigraphic Arabian Plate framework of Sharland et al. (2001). These studies cite the paper by Yousif and Nouman (1997) to represent the Jurassic type section of Kuwait. Yousif and Nouman published the composite log for the Minagish-27 well (see Figure on page 194) and depicted the Jurassic formations and stages, side-by-side, but only in a generalized manner.

In order to refine the ages for this section, I would like to share some preliminary unpublished biostratigraphic and Sr isotope data (see Table and Notes) from analyses by Varol Research (1997 unpublished report), ExxonMobil (1998 unpublished report) and Fugro-Robertson (2004 unpublished report). To convert Sr ages (Ma) to biostages, or biostages to ages, I have used the Geological Time Scale (GTS) 2004 (Gradstein et al., 2004). I thank G.W. Hughes, A. Lomando, M. Miller and O. Varol for their comments.

| Unit or Boundary | Age and Stage | Gradstein et al. (2004) |
|---|---|---|
| Makhul (Offshore) | Tithonian-Berriasian (Bio) | |
| Base Makhul (N. Kuwait) | No younger than Tithonian (Bio) | greater than 145.5 ± 4.0 |
| Top Hith (W. Kuwait) | 150.0 (Sr) = c. Tithonian/Kimmeridgian ? | 150.8 ± 4.0 |
| Upper Najmah (S. Kuwait) | 155.0 (Sr) = c. Kimmeridgian/Oxfordian | 155.7 ± 4.0 |
| Najmah (N. Kuwait) | No older than Oxfordian (Bio) | less than 161.2 ± 4.0 |
| Lower Najmah Shale (N. Kuwait) | middle and late Bathonian (Bio) | 166.7 to 164.7 ± 4.0 |
| Top Sargelu (S. Kuwait) | 167.5 (Sr) = c. Bathonian/Bajocian | 167.7 ± 4.0 |
| Top Sargelu (S. Kuwait) | Callovian or ?older (Bio) | greater than 161.2 ± 4.0 |
| Base Sargelu (S. Kuwait) | middle and late Bathonian (Bio) | 166.7 to 164.7 ± 4.0 |
| Upper Dhruma (S. Kuwait) | early Bajocian and early late Bajocian (Bio) | 171.6 to 169.0 ± 3.0 |
| Dhruma (N. Kuwait) | Bajocian and younger (Bio) | less than 171.6 ± 3.0 |
| Lower Dhruma (S. Kuwait) | ?late Aalenian (Bio) | 173.0 to 171.6 ± 3.0 |
| Top Lower Marrat (S Kuwait) | early Toarcian (Bio) | 183.0 to 180.5 ± 1.5 |
| Lower Marrat (S. Kuwait) | Pliensbachian - ?late Sinemurian (Bio) | 191.9 to 183.0 ± 1.5 |

(Bio) = biostratigraphy; (Sr) = Strontium  Million Years (Ma)

## Notes on Ages

1. The top of the Lower Marrat is early Toarcian based on the common recovery of *Nannoceratopsis triceras*. However the presence of the common-abundant foraminifera *Amijiella amiji* of late Sinemurian-late Bajocian age (Whittaker et al., 1998) most frequently found in the late Sinemurian - Pliensbachian but ranges as young as Bathonian (Powers et al., 1966; Sartorio and Venturini, 1988), could shift the base of the Lower Marrat to late Sinemurian.
2. The Dhruma Formation is early Bajocian-early late Bajocian, based on the frequent occurrence of nannofossil *Watznaueria (Ellipsagelosphaera) britannica* and co-occurrences of the age diagnostic calcareous nannofossil *Carinolithus superbus* with the dinoflagellate *Ctenidodinium* sp. C of Colin et al. (1986) (no lower than late Bajocian) in the upper Dhruma. The Dhruma may be even older (?late Aalenian) based on the presence of (very rare-rare) dinoflagellates *Dissiliodinium* sp. and (very rare-fair) *Dissiliodinium hyalinum* (smooth) in the Lower Dhruma. These biostratigraphic data represent South Kuwait, supported by data from West Kuwait, that show the Dhruma is early to mid Bajocian. In North Kuwait, the Dhruma is not older than Bajocian (biostratigraphy from cutting samples). This suggests that Middle Jurassic paleolows may have preserved reworked rocks with a fossil record sourced from paleohighs; thus the ages of Lower Dhruma and Lower Marrat may be questionable.
3. The Base Sargelu is middle and late Bathonian based on numerous to common occurrence of *Durotrigia filapicata* and the presence of *Gonyaulacysta pectinigera* and *Korystocysta gochtii/kettonensis*.
4. The top Sargelu is Callovian or ?older based on the abundant presence of *Dichadogonyaulax sellwoodii*. According to the average ages in GTS 2004, the estimated age of the top Sargelu by Sr Isotope analyses (167.5 Ma = c. Bathonian/Bajocian Boundary) is significantly older than the estimate obtained by biostratigraphy (Callovian or ?older; i.e. greater than 161.2 Ma).
5. The Najmah Formation in North Kuwait is no older than Oxfordian based on the presence of the dinoflagellate *Systematophora spp.* and the nannofossil *Stephanolithion bigoti maximum* (earliest Oxfordian – latest Callovian) from the lower part of the formation.
6. The Hith Formation from Sr isotope analysis in West Kuwait, is assigned an age of about Tithonian/Kimmeridgian, which would confine the Hith-Gotnia section to Kimmeridgian.
7. In the offshore, for the Makhul Formation, the presence of the dinocyst *Muderongia* sp. cf. A Davy (1979) suggests middle and late Tithonian, and the occurrence of *Phoberocysta neocomica* indicates an age no older than Berriasian.

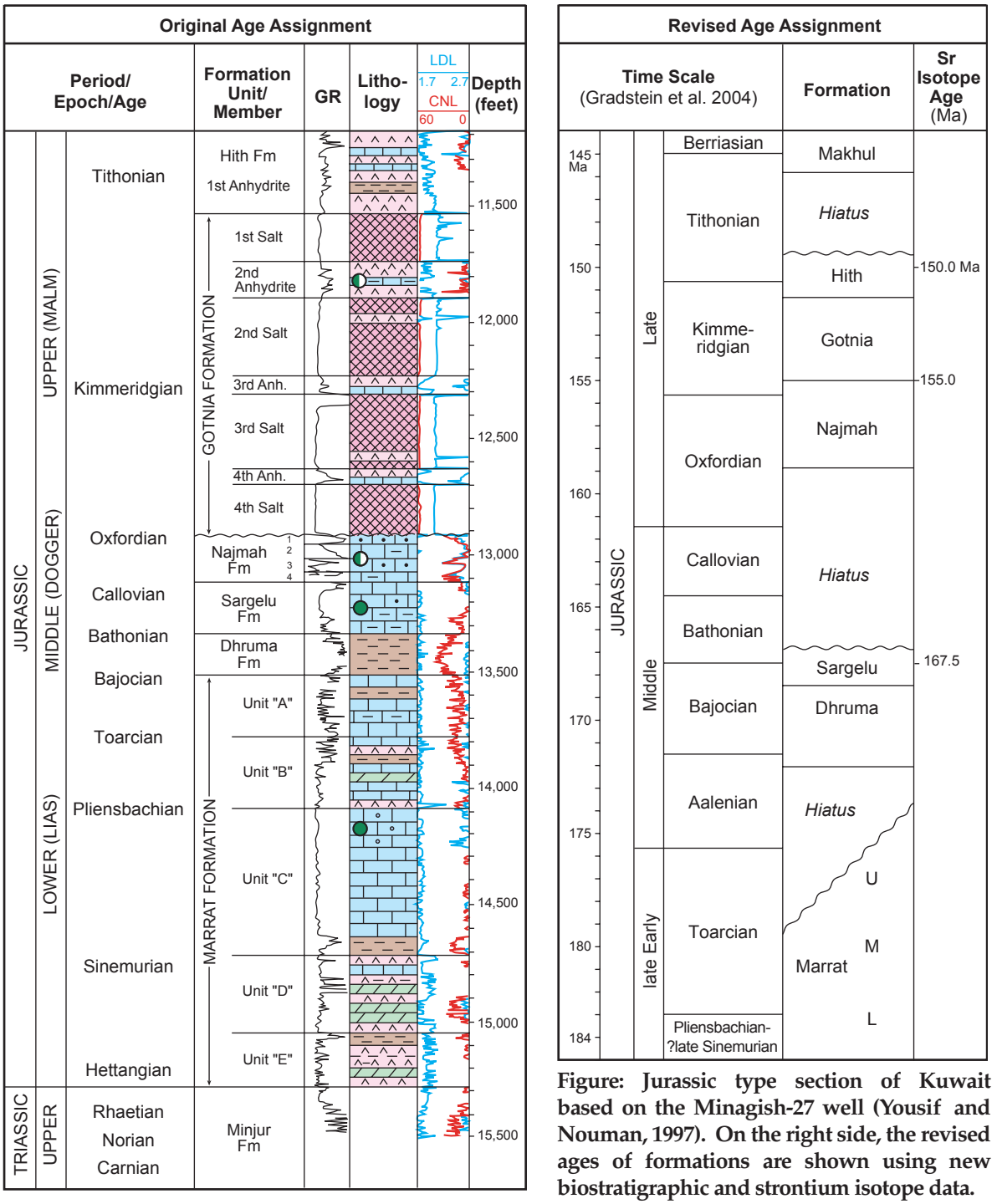


**Figure: Jurassic type section of Kuwait based on the Minagish-27 well (Yousif and Nouman, 1997). On the right side, the revised ages of formations are shown using new biostratigraphic and strontium isotope data.**

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