SC-1-
Interactive comment on “Deglacial sea-level history of the East Siberian Sea Margin” by Thomas M. Cronin et al. R.S. Bradley rbradley@geo.umass.edu Received and published: 17 April 2017 This is an interesting study that attempts to use ostracods of known environmental affiliation to estimate paleosea-level along the continental shelf of the Arctic Ocean. However, as with so many studies of sediment cores from the Arctic Ocean, this paper is bedeviled by dating problems, making the conclusions untenable. The entire interpretation of the lower record rests on undated sediments that are assumed to be of “Younger Dryas” age (~12.9-11.7ka BP) by extrapolation from a date at 417cm (11,112) and 4 samples below it (which are essentially of the same age over 32cm [467-499cm: range in mean age is 11,870-12,079, and range in median age is 11,987-12,094). In this way, the authors conclude that the base of the core, at 609cm, is “approximately 13.5ka”.
Response: See text below

Based on the interpreted age of 13.5ka at the base of the C1 record, the authors then conclude that regional sea-level was 40-50m lower than geophysical models predict, but that discrepancy is entirely based on the assumption that the age extrapolation to the base of the core is correct. A simpler explanation is that it is not correct, and that the basal sediments are older, a possibility that is not considered.
The authors mention (without discussion) that “Unit B’ has 2 facies (B1 and B2). The first time this is mentioned is in Section 4.1. This “lithologic transition” does not enter into their assumption of a linear sedimentation rate below the lowest date (which appears to be in unit B1) but may explain why the sediments towards the base of the core are older than assumed. It also appears that the 417cm sample is immediately below a hiatus of unknown duration in the core. A hiatus in the record seems highly likely. From ~11.5-11.0ka B.P., (MWP-1B) sea level rose by 16m (>3m/century). During this time, water depths at the core site would have been quite shallow, and it is hard to imagine that sediment deposition in this dynamic environment was not completely disturbed. It also seems unlikely that the ~8500 B.P date (on unidentified organics) is correct as this would imply a dramatic reduction in sediment deposition from ~2835 to ~8500 BP., followed by a sharp increase. The discussion of core 20-GC [Section 3.2] is bizarre as there is no consistency in the dates on that record, and the authors simply decide to ignore older ages as being reworked, concluding that the entire record is “probably around 11ka”. Similar logic is not applied to old dates on samples dated in cores 23-GC and 24-GCâA˘Tthese are ˘ accepted as correct. There is also a puzzling use of reservoir correctionsâA˘T300 years for the upper section, ˘ but only 50 years for the lower section. In a recent paper–on which the first author here was a co-author (Poirier et al, 2012, Marine Micropaleontology) a reservoir age of 1,000 years was used for samples >10,000 years, as Hanslik et al., 2010 (QSR) also did. One might expect that restricted circulation in the Canada Basin, prior to the opening of Bering Strait, would result in “old water” in this area, requiring a bigger C2 reservoir correction. That would shift the age of the radiocarbon dates in Unit B1 towards younger calibrated ages. Other points: Inconsistencies in core IDs (in text, Figure). Also appear to be errors in Lab ID of C-14 dates in Table [some numbers are duplicated

and Beta-455001 in Fig 4 not listed]. This often makes it a challenge to follow the arguments in the paper. The conclusions reached in the paper are unconvincing. Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2017-19, 2017.

Response: Before addressing each point individually, let us recount the data presented and interpretations: We interpreted a shallow water sediment sequence 500 to 413 cm core depth with 5 calibrated C14 ages centered on 12 cal ka as being deposited in shelf environments during the Younger Dryas. An abrupt stratigraphic break [hiatus, condensed zone] at 413-400 cm, documented by faunal, geochemical, physical properties and consistent with well mapped geophysical units along an extended region of the Siberia shelf slope break, is dated near the end of the YD ~ 11.2 to 11.0, regardless of what delta R reservoir correction one uses. The lowermost part of the core 600 to 500 cm is not dated.- see new paragraph below discussing this.
The upper 400 cm of the core, part of the Holocene, is not germane to the topic of the paper, late glacial sea level, and the new radiocarbon dates are not critically assessed.

In light of prior studies of sedimentation deposited during rapid marine transgressions in coastal settings, this record is a textbook example of complex patterns that are not necessarily easy to interpret, but similar to what you find in places like the Black Sea, Chesapeake Bay, the Gulf of Mexico, Sunda Shelf, Tampa Bay and most post glacial Marine settings flooded due to glacio-isostacy. In fact our study region has resemblances to tropical coral reef records of sea level where the evidence for rapid SL is <u>the lack of U-series ages</u> and stratigraphically jumbled coral rubble in key core intervals ! In addition, paleodepth estimates from corals are highly dependent on the particular coral genus studied and in the Pacific can be quite large. So the review seems to be ignoring the broader understanding of the stratigraphy and sedimentation along continental or island margins during rapid transgressions. Nonetheless, we shall try to accommodate his/her concerns.

The reviewer is correct. Arctic Ocean sediment records involve dating uncertainty. Whether this problem is unique to the Arctic, to radiocarbon dating, to semi-enclosed basins, or any other marine body of water is arguable. Nonetheless, we agree with the reviewer there is a need to urge caution and we copied below, in smaller font and underlined, our response to the other reviewer who raised similar points. Note however

a) using different delta R values on the date near the main transition, Unit B/A boundary, 400-413 cm core depth, changes the age only slightly (a range of 118 years, from 50, 300, 500 year delta R values) (see Supplementary Figure S1 in Jakobsson et al. CP this volume).

b) the interval 420-500 cm 4-PC1 core depth has 5 dates with calibrated age ranges almost all within the YD from ~10.8 to 12.5 cal ka. The sediments contain shelf faunal assemblages.

c) **we inserted this sentence on page 6: "The core 4-PC1 river-intermediate assemblage centered about 12 ka suggests an early to mid Younger Dryas transgression of this region, although the rate of transgression cannot be quantified from the faunal shifts alone, and additional study of the age of the lowermost sediments in 4-PC1 is needed."**

Copied from response to Taldenkova review: The use of a particular reservoir correction in the Arctic has been contentious for years and we do not deny there may be several choices both for calibration [see Hanslik et al. 2013 QSR] and choice of material dated. For our particular Siberian and Chukchi margin cores, we refer to the papers of Pearce et al. and Jakobsson et al., both in this CP volume, for our rationale in using a lower delta R number (50 yrs) for the pre-Holocene/Deglacial than for the Holocene (200 yrs). In our own text, this is made clear on page 4. In Jakobsson et al. Supplement Fig 1, using 3 different delta R values (50, 300, 500 yrs) for NOSAMS date 131218 results in about 118 year range in calibrated ages (11,065, 10,788, 10,547 years) at the time the Bering Sea was flooded, roughly 11,000 years ago. The ages on the dated sections of the SWERUS cores may or may not be equivalent to those from the Laptev Sea.

And…
We noted the age uncertainty in the revision; calcareous fossils were not abundant enough below this level to obtain an AMS data. The text reads "possibly" in regard to marking the onset of the YD.

Response to reviewer 1 regarding age below 500 cm. The reviewer suggests an older age for the 600-500 cm interval, suggesting our parsimonious assumption of extrapolating down core is wrong. But he/she offers no alternative age? 15 ka? 20 ka? (it must be an age that is consistent with the shallow-water nearshore faunas). The reviewer also proposes that reworking of faunas and/or dated material occurred, but on what evidence? But there is excellent consistency in all chemical, physical, microfaunal proxies from this core (see other papers on core 4-PC1 in the CP volume). We note also that another reviewer proposed the opposite of reworking, instead downslope transport as she had observed in the Laptev Sea. But the Siberian margin 4-PC1 core lacks evidence of reworking and downslope movement. In contrast, core 20-GC1, obviously has rapid sedimentation, an inadequate age model, sediment mixing, but nonetheless it recovered 35 cm of sediment containing shelf microfaunas dated at 13.2 to 11 cal ka.

We clarify age uncertainty in the revision by inserting the following paragraph, which hopefully will spur more research:

"Before interpreting the Siberian and Chukchi Sea deglacial sea level chronology, it is useful to examine the broader patterns of LGM and deglacial sedimentation in the Arctic Ocean for context. Marine sediments deposited during the last glacial maximum are uncommon in the central Arctic Ocean

due to the extensive sea ice and ice shelf cover. For example, Polyak et al. (2004) documented a hiatus between 19 and 13 ka in several cores from the western Arctic. In a compilation of 199 new and published calibrated radiocarbon dates from the central Arctic Ocean, Poirier et al. (2012) found similar results: no dates at 21-22 ka, 4 total from 19-15 ka, 4 dates from 14-15 ka, 5 dates from 13-14 ka, and a spike up to 13 dates between 12-13 ka. Several studies of Arctic Ocean margins have recovered deglacial sediments. Taldenkova et al. (2013) found the earliest deglacial dates of 15.34 and 15.37 ka in core PS51/154-11 at 270 mwd in the Laptev Sea. These correspond to the first appearance of common benthic foraminifera. Scott et al. (2009) dated sediments from piston core PC750 (1000 mwd) off the Mackenzie Trough, on the Canadian margin, at 11.3 cal ka at 180 cm and 13.3 ka at 380 cm. Benthic foraminifera first become common in core PS750 at ~11.3 ka. In core PS2138-1 (995 mwd) from the Barents Sea slope, north of Spitzbergen, Wollenburg et al. (2004, see also Matthiessen et al. 2001, Norgaard-Pedersen 2003) dated one of the more complete LGM- deglacial sequences with nine calibrated radiocarbon ages from 23.88 to 15.52 ka from 275 to 65 cm core depths. Unlike the Laptev, Siberian and Canadian margins, relatively continuous sedimentation in this region during this period reflects complex changes in productivity and oceanography during Greenland Stadials GS-2 (21-14.6 ka) and GS-1 (14.6-11.6 ka, Bølling-Allerød, Younger Dryas) largely due to changes in inflowing warm Atlantic Water and the West Spitzbergen Current. In sum, these few examples show that the earliest ages for deglacial sedimentation and preservation of abundant benthic microfaunas (and by inference productive benthic ecosystems) varies along different Arctic Ocean margins. In regards to the undated interval in 4-PC1 core from 609-500 cm core depth, this means that pending further investigations, we cannot completely exclude the possibility that the lowermost sediments below 500 cm core depth in 4-PC1 are older than ~13 ka."