Abstract –

This could state that the paper presents an approach to palinspastic restoration that is radically different from from the usual methods.

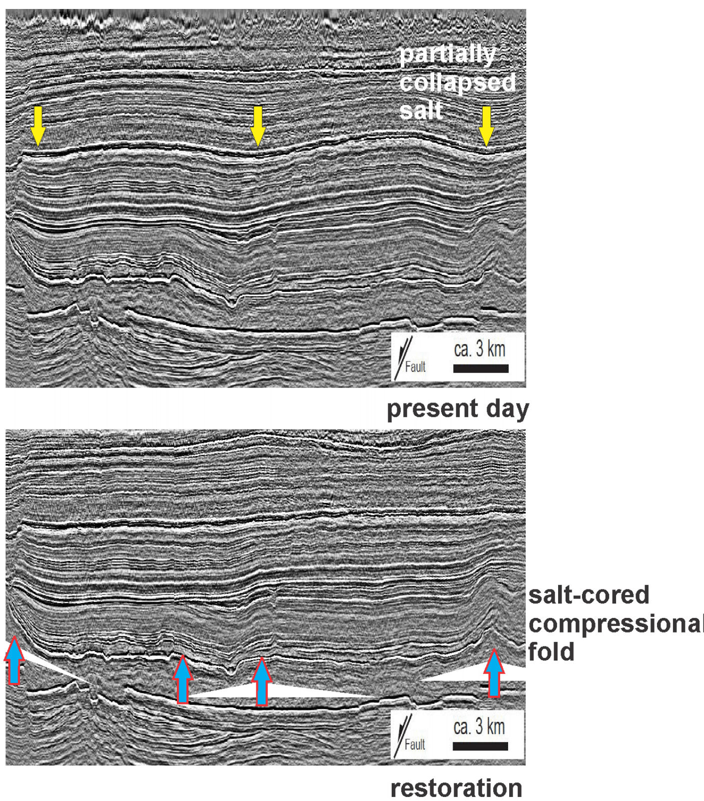
Introduction (line 75)

I think that you need to say more about the geological setting and structural style of the salt here.

To introduce the salt structures

It’s significant that there do not appear to be any diapirs or salt-withdrawal basins in the region (at least as far as I can tell from your maps and sections) – this could be invoked as supporting evidence for the statement that the sediments remain less dense than salt.

It’s also significant that there are salt structures, and that these salt rollers, anticlines and walls appear NOT to be diapiric, instead they are the product of lateral shortening. This again should be stated, because it’s important.



And thirdly, it looks like many of the compressional salt rollers, anticlines and walls did not grow further when they were buried, and indeed, it looks like the *opposite* happened; many of the early salt-cored highs saw the salt flow OUT of the highs, as illustrated by line X-X’ (here is a quick and dirty reconstruction that illustrates the point). Again, I think this is important to say, because it also provides supporting evidence that the cover section was less dense than the salt.

I suggest that it is really important to describe what sort of salt structures you are dealing with before launching in to how you restored them.

Sediment densities and compaction (line 105)

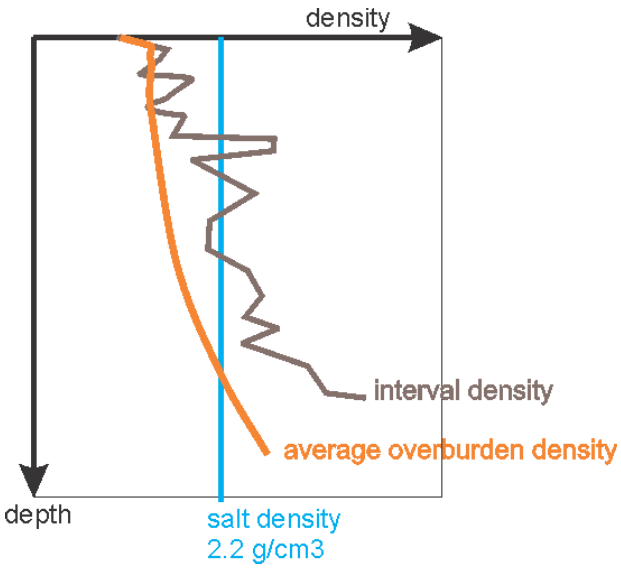
The statement that the *average overburden density remains lower than that of salt in all cases* is surprising, and this probably needs more justification. My own research on this subject has indicated that many common sediments are deposited with density close to that of salt (e.g. most platform carbonates, most “dirty” continental clastics such as typical fluvial deposits), and that those that are substantially less dense than salt at time of deposition tend cross over in density at about 1km of burial. The density crossover in most basins appears to be at around 1km or shallower. This scenario has been described in several publications. You may well be right about your study area being different, and always maintaining average density lower than salt, but you should note that it appears to be an exception to the most commonly described situation in other basins.

I think that you are correct in your study area, and I suspect that the two main reasons why your study area has this property, (which is unusual on the global stage), are that:

1. The Chalk is an unusual (strong and low density) rock – it is a limestone with extremely high initial porosity (thus extremely low initial density compared to "normal limestone") and this porosity can be preserved at depth if the pore fluids are sealed in. For example, the high initial porosity in the Ekofisk Field was preserved (with 30-50% porosity at depth), because the pore fluid could not escape until the field went on production – at which point the rock fabric microstructure collapsed and the Chalk compacted.
2. The depth of burial has never been very great (<2km or so total, chalk burial <1km). Not great enough to collapse the Chalk porosity.

The other factor that you should mention at this stage is to quantify the typical thickness of the suprasalt sediment section in your study area. EVERY type of sediment will become more dense than salt at some depth! If the typical thickness was <1km or so, then it would not be surprising that the sediment is less dense than salt. But given that the total thickness of sediment above salt is about 2km on line X-X', (fig 5), I was quite perplexed, and I suspect that so will be many of the readers.

Perhaps a simple density/depth plot would be helpful.



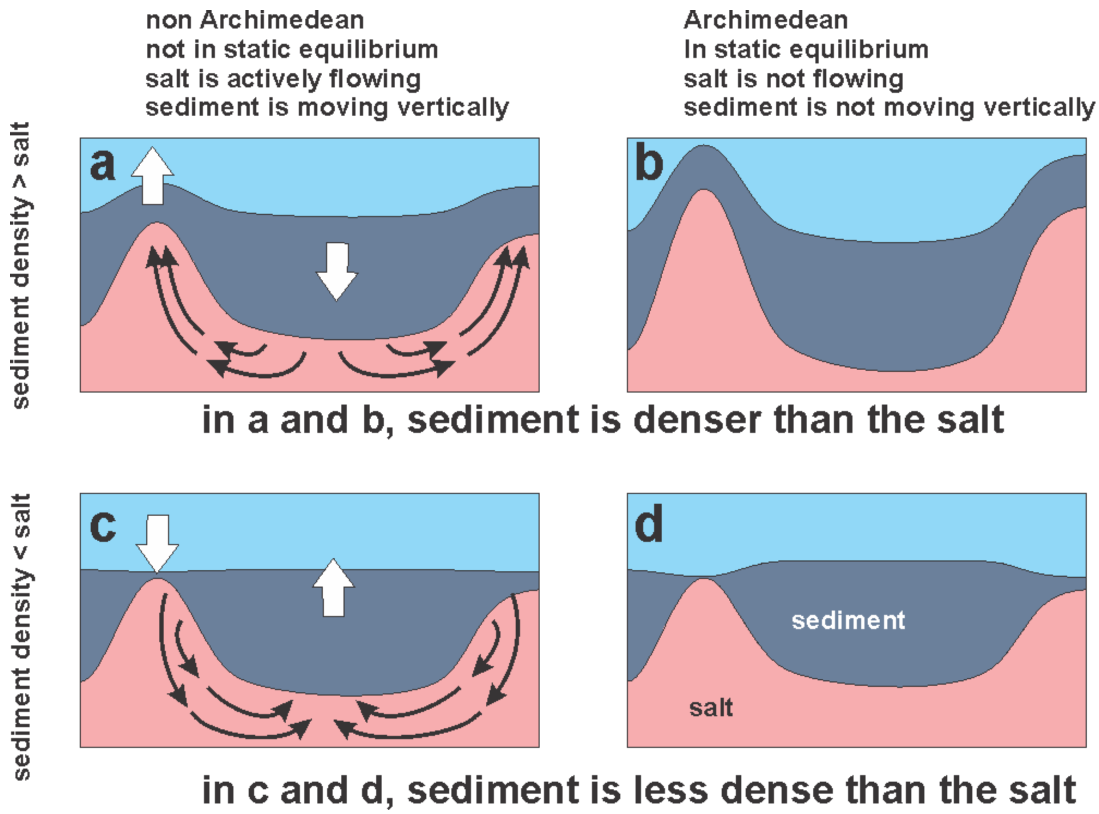
The lithologies used need clarification, and it would be good to list the % sand. When you write that the Upper North Sea Group is sandstone, are you saying that it is 100% sand, or that it is (say) 60% sand/40% shale?

Can you state whether the density/depth relationships were taken from Sclater and Christie without modification, or whether they were cross-checked against the density indicated by wireline log data in the study area?

At the end of the discussion, I think that it would be valuable to add a paragraphs that compare/contrasts your method with conventional restoration, and a paragraph that discusses where the method might be applicable and when it might not.

I believe that your method could apply equally well for scenarios where the sediment is less dense than the salt, and in scenarios where the sediment is denser than the salt. This is worth saying, because otherwise the reader might interpret that the method only applies where the sediments are less dense, as in your study area.

However, the method only applies where the salt has had enough time to flow so that the sediments and salt can approach Archimedean equilibrium (as shown in b and d in the sketch below). In situations where the geology has not yet achieved Archimedean equilibrium (a and c , in the sketch below) the method will not be applicable. I suggest that a near-equilibrium scenario can be achieved where the rate of sediment accumulation is relatively slow (e.g. in the North Sea, and in your study area, or in the Pricaspian Basin of Kazakhstan). But in regions where the sediment accumulation rate is very rapid (e.g. the Cenozoic Gulf of Mexico, Kwanza and Congo basins of Angola, Santos Basin of Brazil) the basins are actively subsiding, the salt diapirs are actively rising, and the whole ensemble is far from equilibrium. In such settings, I would not recommend the use of your method.


non Archimedean
not in static equilibrium
salt is actively flowing
sediment is moving vertically
Archimedean
In static equilibrium
salt is not flowing
sediment is not moving vertically
sediment density > salt
a
b
in a and b, sediment is denser than the salt
sediment density < salt
c
d
sediment
salt
in c and d, sediment is less dense than the salt