Chalk and cheese: successes and misadventures in plaster jacketing fieldwork finds.

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Abstract

Plaster jacketing large fossils such as the remains of prehistoric vertebrates to enable their safe removal from the field is a procedure that has been used by palaeontologists for over a hundred years, mostly with great success. However, it is not a foolproof technology and making a strong field jacket that will securely protect the contents without failing relies largely on experience, patience and common sense.

However, it can also depend upon the weather, the location, the substrate and what you use or fail to use with to the traditional simple ingredients of plaster of Paris and hessian. The recent discovery of a 10m-long ichthyosaur skeleton (the largest ever found in the UK) in Toarcian Jurassic clay at Rutland Water, UK, provided some challenging conditions when it came to removing the bones from the site. The size of the find was not really the issue: large jackets containing the skull and abdomen - weighing 1 tonne and 1.5 tonnes respectively - were lifted quite successfully. However, a couple of the smaller jackets, still each weighing a quarter of a ton, were not so successful. The varied weather played a role, as did being downwind from a large reservoir (providing us with very moist air) but the high mineral content of the local tap water used for the plaster may have tipped the balance.

Plaster field jackets

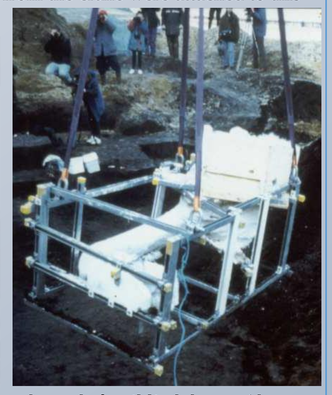
'Field jackets', when made correctly, provide protection for fossil material uncovered in fieldwork, keeping the weather from damaging the find and protecting the specimen as it is lifted out of the ground and transported. It also keeps articulated bones in their exact association, critical for taphonomic studies etc. The single biggest mistake is to make the layer of protective plaster too thin – it just won't do the job. Also, forgetting to add hessian/burlap. Useful guides to making successful plaster jackets is given in Leiggi & May, 1994, and Croucher & Woolley, 1982. As I have had had a variety of experiences making plaster field jackets in a range of circumstances over the years and, crucially, have also had to remove them from fossils, I thought some ideas would be worth sharing.

Example: Woolly Mammoth tusk

In 2019 I had to excavate and lift a very fragile tusk of a woolly mammoth at the Cotswold Water Park. Essentially it was several thousand splinters of mammoth tusk preserved in a tusk shape, just waiting to fall apart. A relatively straightforward job, but this work was to be filmed for the BBC TV documentary "Attenborough and the Mammoth Graveyard". The specimen required consolidation first, then the usual field jacket of acid-free tissue, masking tape, foil, plaster of Paris and hessian to make a thick sturdy jacket, including covering as much of the underside as possible (right) before it was lifted. A simple sturdy wooden splint was attached with plaster to help keep it rigid (above). The de-jacketed and conserved tusk is perfect (right).

Example: the West Runton Mammoth

The West Runton Mammoth is an 85% complete skeleton found on the north Norfolk coast in the 1990s and is one of the best examples of this species (*Mammuthus trogontherii)* in the world and in life would have been much larger than a modern male elephant. The skull, with its right tusk attached, was protected with a traditional plaster jacket but it was so large and heavy, with such an irregular shape including the vulnerable tusk, that it had a protective frame of 'Unistrut' channeled steel assembled around it, to keep everything rigid (below, right). The slings from the crane were attached to this frame. It worked perfectly.



However, the impressively large but sub-fossil limb bones (the femurs are 1.5 metres long) were considered so vulnerable that stiff wire mesh was added to the plaster of Paris to reinforce the jackets (above left). I DO NOT RECOMMEND THIS! It is not necessary if the jackets are made correctly and it creates a safety hazard on site with sharp pieces of mesh sticking out when applying the plaster. Also when all the bones had to be de-jacketed, it was a constant hazard to the conservator (the author) when removing the field jackets as well as making the task much more difficult.

Example: the Abu Dhabi humpback whale

The excavation of a 5,200 year-old sub-fossil humpback whale skeleton in Abu Dhabi in 2009 included lifting the fragile skull that was 4m long by 2m wide and, separately, the two associated 4m long mandibles. Once the fragile but huge bones had been cleaned, recorded and consolidated they had sturdy plaster field jackets made around them the usual way and then, like the West Runton Mammoth skull, a sturdy rigid frame was bolted together around them out of lengths of channelled steel (Unistrut). The plaster jackets were attached to this with more hessian and plaster. Additional rigidity was provided by using wooden beams as diagonal braces (cheaper than steel). The three huge field jackets were safely lifted from the excavation with ease. Although the temperature was regularly above 40°C and RH close to 100 %, there were no issues with the plaster setting too quickly or too slowly.

Example: The Rutland Ichthyosaur

In January 2021 the largest ichthyosaur skeleton ever found in the UK (a *Temnodontosaurus*) was discovered in a lagoon at Rutland Water after the water levels were lowered for maintenance. We could not return to excavate the 10 metre-long skeleton until late August when the water levels would next be low enough and when we would least disturb the birds etc (it is a wildlife reserve). We expected the weather to be fine and warm at that time of year which would help, but that wasn't always the case (see photo top left of the poster where we are wearing woolly hats and anoraks!).

Although the skeleton is almost complete and the bones have good surface detail they are quite fragile, not well fossilised. The ribs and skull are heavily cracked. This meant that we had to lift the whole skeleton in a series of 12 plaster of Paris field jackets (see photo top right of the poster). This decision was reinforced by the fact that the skeleton exhibited some interesting taphonomy (e.g. scavenging) that needed to be preserved even though the bones were also plotted on a scale diagram and were 3D scanned during the excavation. A steel framework was not required, even for the largest sections (e.g. the 3m x 1.5m abdomen and 2m x 1.5m skull) as the specimen was fairly flat. Also, 3x2" wooden beams are much cheaper than steel.

Although surrounded by water in the reservoir, this was a health hazard due to all the birds faeces etc and also would have impurities from the clay substrate which would adversely affect the setting of the plaster, so we had to bring tap water in containers to use on site.

Right: Tunnelling through the Jurassic clay underneath the 2m long skull to get plaster of Paris and hessian right underneath the specimen. Wooden splints were then screwed together above and below and secured with plaster. This field jacket containing just the skull of the ichthyosaur weighs just under one tonne and was lifted from site successfully.

Left: Four members of the excavation team reducing the size of the pedestal of Jurassic clay under the large plaster jacket containing the abdomen, and adding plaster to the underside. Note the size and depth of the trench required to access the underside, to complete the jacketing.

Right: Successfully lifting the c. 1.5 tonne plaster field jacket containing the abdomen of the ichthyosaur, by attaching the slings to the sturdy wooden frame.

Two plaster field jackets (out of 12) did not set properly during the excavation. The cold damp weather that particular week and constantly being downwind from the large reservoir combined - possibly with the high mineral content of the 'hard' local tap water - to retard the setting of the plaster so much that it did not set for several weeks. Had we known this might happen, we would have brought zinc sulphate with us to improve the setting of the plaster.

The two jackets were still the consistency of cheese when removed from the site and had to be handled very carefully, despite weighing about a quarter of a tonne each. We feared the contents would be damaged but actually, once the plaster finally set and was reinforced and the jackets were opened, it was found that only the clay had cracked, not the bones (right).

Conclusions.

Channeled steel lengths (e.g. Unistrut) can be bolted together to make even quite large rigid frames to keep big, fragile and awkwardly shaped specimens safe in their plaster field jackets so that they do not flex or break under their own weight when lifted. Even wooden beams (a much cheaper option) can be deployed to successfully lift plaster field jackets weighing up to 1.5 tonnes, if they are used correctly and with some forethought, securing them underneath the plaster jacket and screwing them together. Placing wire mesh within the plaster is not necessary at all and is positively dangerous for all concerned, both during the excavation and later in the de-jacketing and preparation/conservation phase.

Plaster of Paris usually sets well, even in relatively poor weather conditions, but obviously warmer and drier conditions help. It is worth - whenever possible – planning the application of plaster to coincide with better weather conditions although if too warm and sunny the plaster will possibly set too fast to allow sufficient working time. Additives can be used to advance or retard the setting time but it is worth being aware that the mineral content of the local water supply may also affect the setting time adversely if all other elements are also against you.

Despite the problems encountered when making two of the smaller (quarter-tonne) plaster jackets in Rutland, and against our expectations, the contents of even these field jackets appear to be very well preserved, with only the Jurassic clay developing cracks.

References

Croucher, R. and Woolley, A.R., 1982. *Fossils, minerals and rocks: collection and preservation*. British Museum (Natural History).

Leiggi, P. and May, P. eds., 1994. *Vertebrate Paleontological Techniques: Volume 1* (Vol. 1). Cambridge University Press.

To read about the excavation of the Rutland Ichthyosaur see the link below or Google "Rutland Ichthyosaur Larkin GCG Blog":

https://geocollnews.wordpress.com/2022/01/10/excavating-the-rutland-sea-dragon-the-largest-ichthyosaur-skeleton-ever-to-be-found-in-the-uk/comment-page-1/

Acknowledgements

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