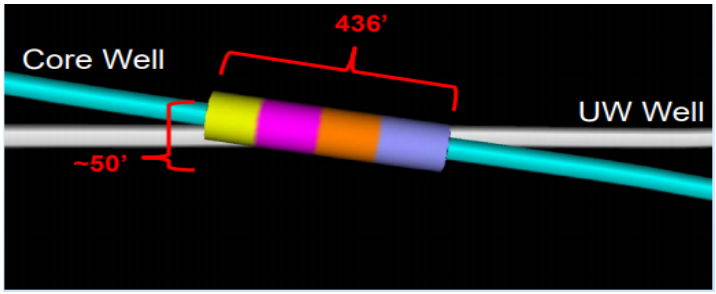
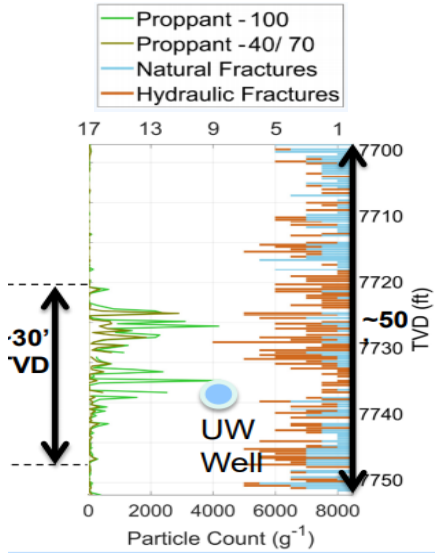
DEEPROP: The Key to Unlocking the Full Production Potential

After such a difficult period over the last year and a half, we've learned a couple of things. Foremost is that bigger isn't always better and playing IP economics is a risky proposition in the oil and gas industry. Where do we go from here? Well it's back to the fundamentals of engineering, to identify the challenges we have with producing from unconventional shale plays and designing a solution.

We're in luck as many have already identified what our challenges are and where we have opportunities. Our biggest challenges are damage mechanisms that occur very rapidly in the low permeability plays that we're targeting. Our biggest opportunity discovered by the GTI core through experiment, is propping the complex fracture networks that are being generated and dilated during the hydraulic fracturing treatment.

Figure #1: Fracture distribution and proppant distribution discovered during the GTI core-through experiment.





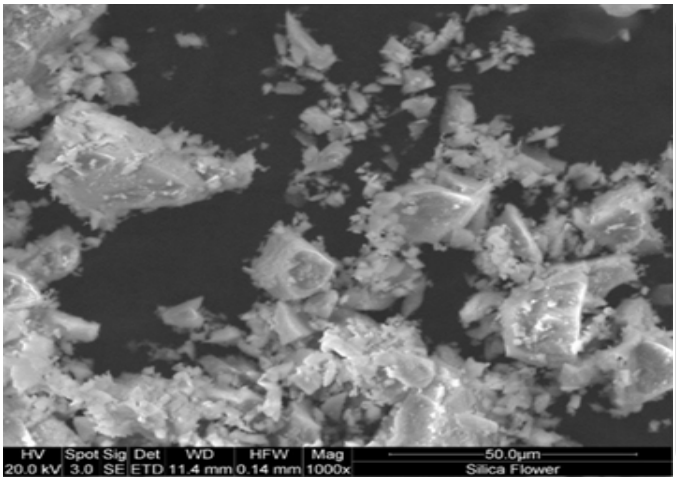
Hydraulic Fracture, Natural Fracture and Proppant Distribution (GTI, 2019).

The challenge of propping these microfracture systems is finding proppants that are small enough, retain a high degree of permeability and have a high crush strength. This will allow the proppant to enter the narrow microfractures, retain its shape over time as the effective stress increases and efficiently transport the reservoir fluids.

Fortunately, Zeeospheres™ has a product that meets all the requirements of an efficient microproppant. The product is called DEEPROP®. DEEPROP® is a man made ceramic microproppant that has a high conductivity, a high crush resistance and has a D90 of less than 70µm (.0027in). This allows DEEPROP® to comfortably enter and prop fractures that are less then 0.21mm (.008in), the D50 is less than 25µm (.001) which means that DEEPROP® can theoretically enter and prop fractures as small as 0.075mm (.0029in), a huge advantage over conventional proppant dimensions.

Figure #2: DEEPROP® versus silica microproppant structure, the jaggedness of the silica proppant would severely impair permeability.

Silica Flour Microscopic Structure (50µm Scale)



DEEPROP® Microscopic Structure (50µm Scale)

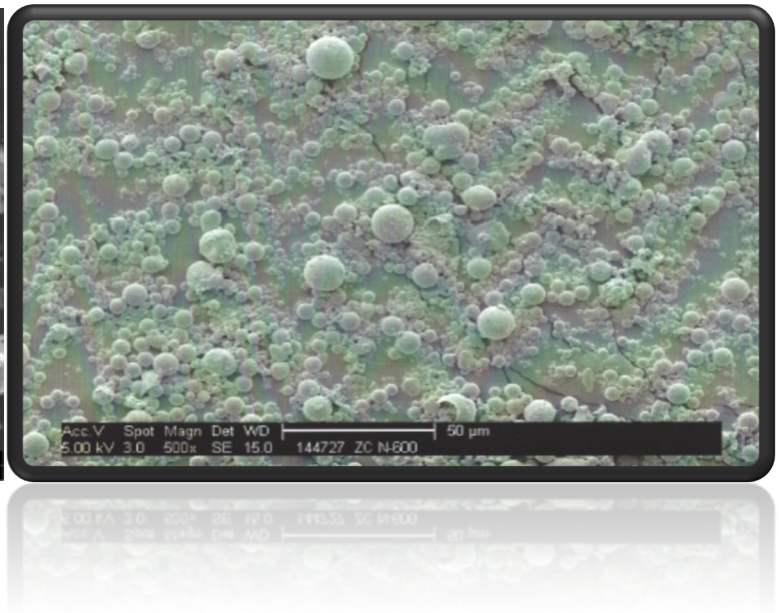
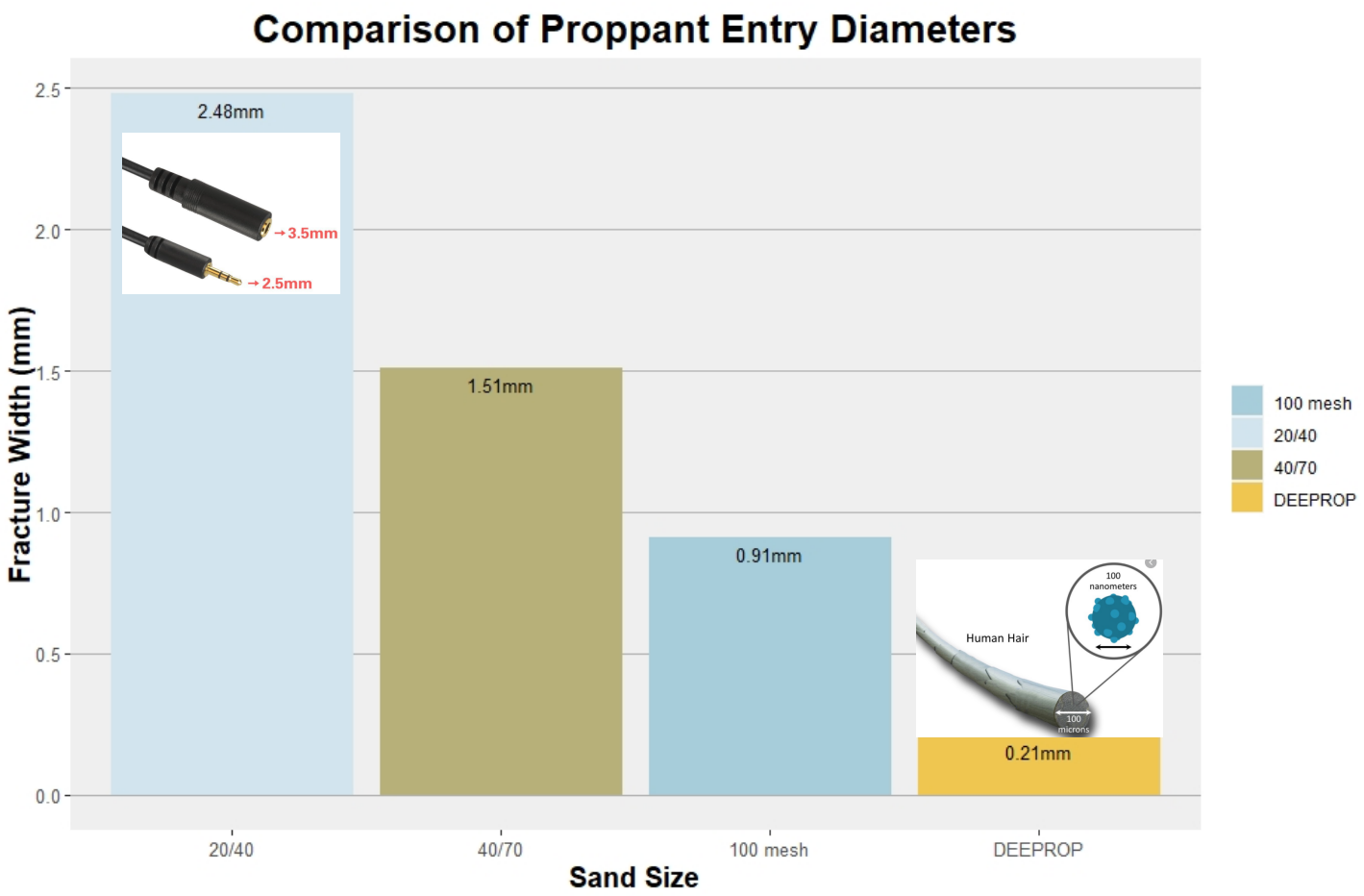
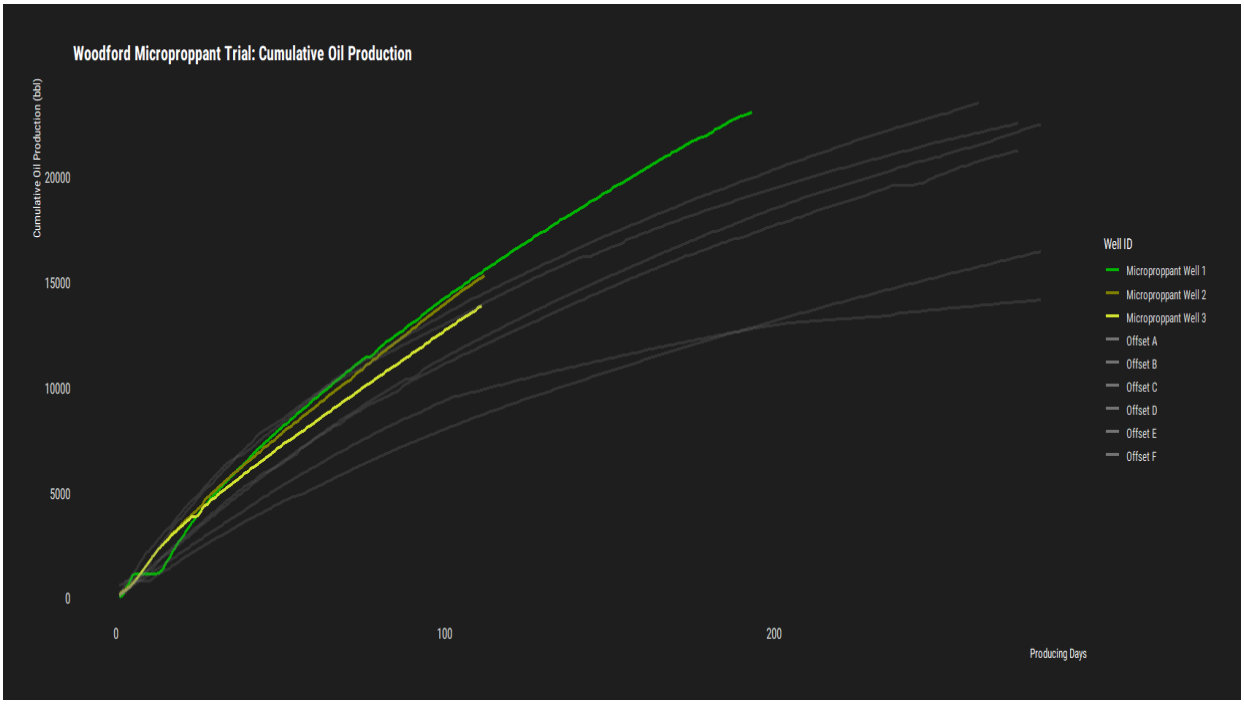


Figure #3: DEEPROP® can prop fractures smaller than a human hair.



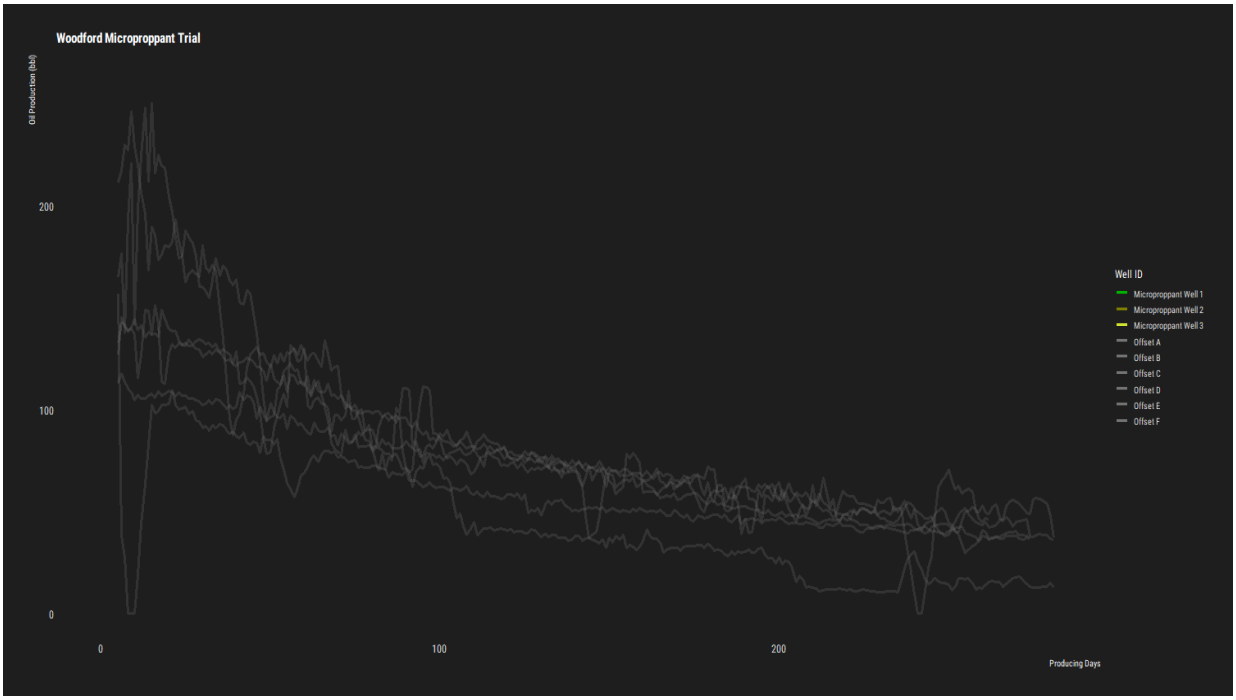
DEEPROP® has currently been trialed in +250 wells in 7 major U.S shale plays, the Permian, Woodford, Utica, Marcellus, Eagleford, Bakken and Barnett. Results from 5 plays has been published in SPE-19974-MS and presented at HFTC - 2020, the Permian, Woodford, Utica, Barnett, and Marcellus. Two plays have trials in early phases, the Bakken and Eagleford, the data is not yet public but initial results are showing promise. The published results have averaged a total production increase of between 25-40% in the Permian, Woodford, Utica, and Barnett.

Figure #4: All Microproppant Wells on trend to outperform direct offsets for a 9 well study in the Woodford.



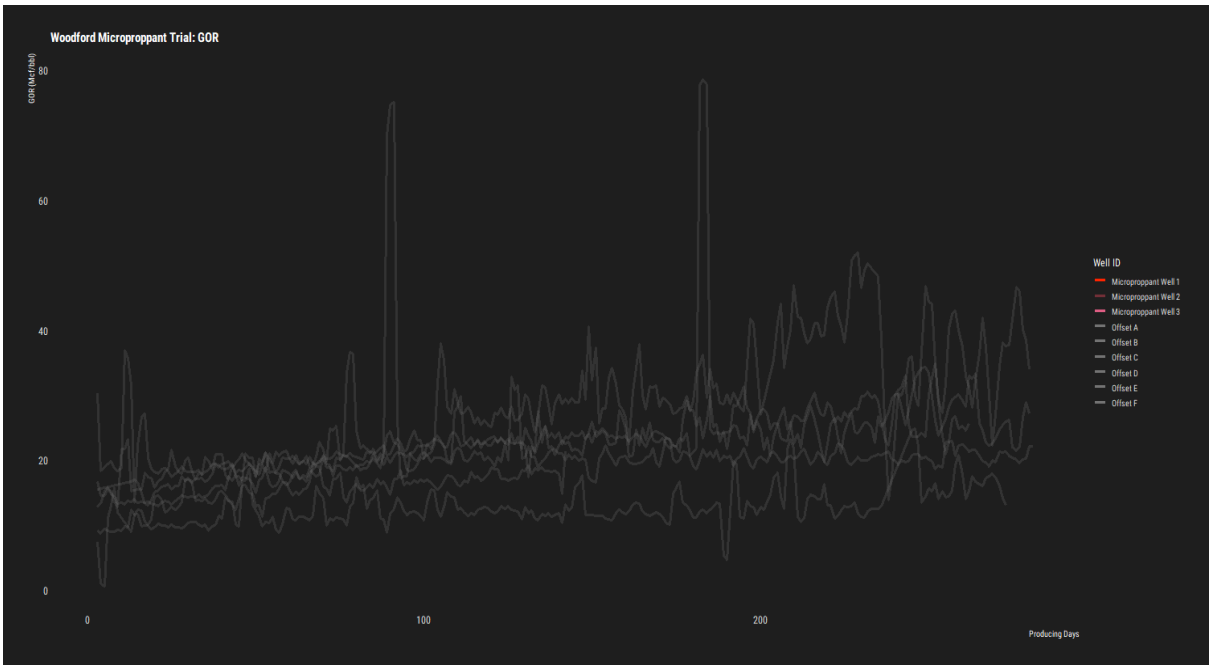
What's typically seen in production profiles of DEEPROP® study wells are lowered decline rates. We're not sure exactly what's driving these results, but the proposed mechanisms are increase in effective propped fracture area, near wellbore scouring, far field diversion and reduction of convergent flow effects. This could result in much slower development of damage within the fracture system and reservoir matrix allowing production to decline much more slowly.

Figure #5: Microproppant wells decline much more slowly for a 9-well study in the Woodford.



For DEEPROP® to be effective the matrix permeability needs to be less than 5μD, this is to ensure the matrix does not provide a more efficient flow path for the reservoir fluids. The formation must exhibit pressure dependent leak-off behavior, there must be a complex fracture network that is either being created during the completion or a natural fracture network that is dilated. The isotropic stress regime of the Marcellus does not allow for the development of a complex fracture network and was the only play where DEEPROP® did not generate significant benefits. Finally, the rock modulus should be greater than 17GPa, this is to ensure the proppant does not embed into the formation-fracture interface and allow closure of the microfractures.

Figure #6: Microproppant GOR profiles are much flatter than the offset wells for a 9-well study in the Woodford.



A 3 well, 3-year trial in the Utica just concluded where one well was completed with DEEPROP® in every stage and one well was completed with DEEPROP® in half the stages, were benchmarked against a direct offset completed without DEEPROP®. The results were astounding with the well treated with DEEPROP® producing 50,000 bbl more liquids and 300,000 mcf more gas than the direct offset. This resulted in an ROI of 24$ USD in

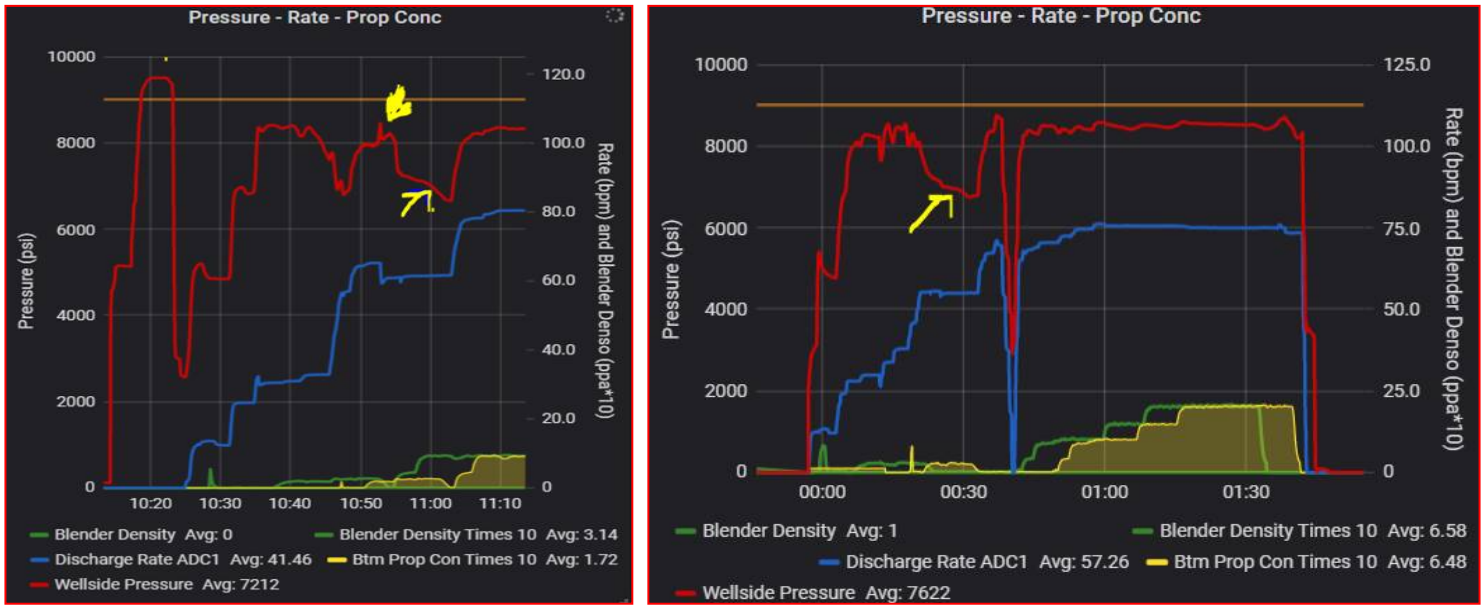
production value for every 1$ USD invested in DEEPROP®, assuming $45/bbl and $2.50/mcf. It's a no brainer to try DEEPROP® with that kind of potential uplift.

Figure #7: 3-year Utica trial, huge difference in cumulative production between the well completed with DEEPROP® and the offsets.

Figure #8: 3-year Utica trial, oil production decline between the well completed with DEEPROP® and the offsets.

As an additional benefit, DEEPROP has been shown to reduce surface treating pressure which not only allows operators to complete wells faster, but can allow operators to place proppant in operationally challenging environments (deep, high pressure reservoirs). We believe this is achieved by near wellbore abrasion as DEEPROP® enters the tortuous near wellbore constriction created as the fracture re-orients, it abrades this constriction, reducing pressure during the treatment. This might also help with convergent flow effects during production.

Figure#9: Pressure drop as soon as DEEPROP® hits the perfs, the operator budgeted 7 days to complete the treatment but they finished it in 6, saving 1 day worth of treatment costs.



There have been over 250 wells in 7 major U.S shale plays completed with DEEPROP®. With the exception of the Marcellus, the results have been an average production uplift of between 25-40% in total production over multi-year studies. DEEPROP® lessens the very steep production declines associated with unconventional shale play and allows operators to maximize the ROI for each well.

If you're interested in discussing how DEEPROP® can add value for your operation, please get in touch.

✆ - 1.504.909.8102
- Info@DeepropFrac.com