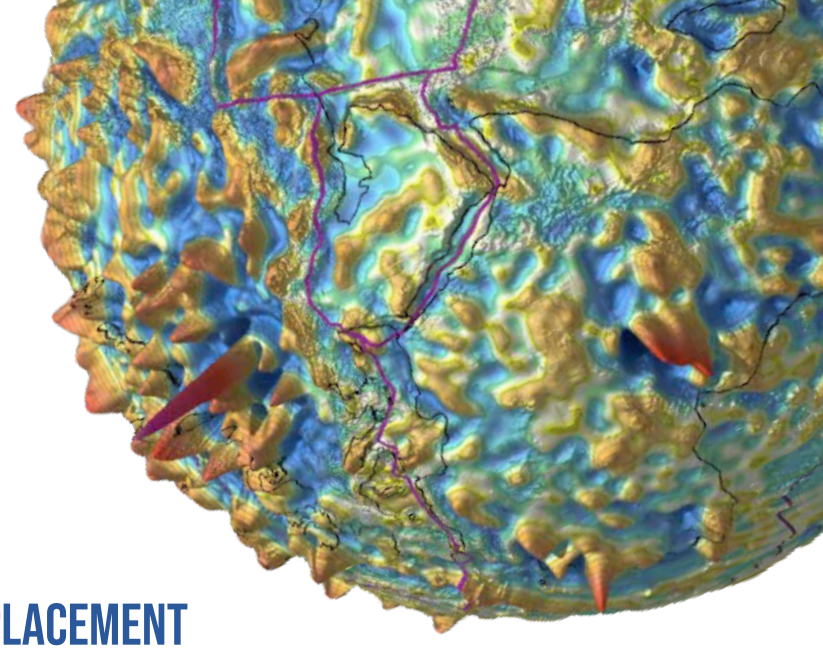
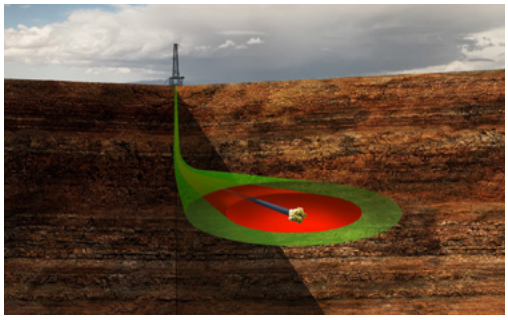


H&P GLOBAL GEOMAGNETIC MODELS

Effortless survey management solutions
by the proven industry leader

REDUCING UNCERTAINTY IN WELLBORE PLACEMENT

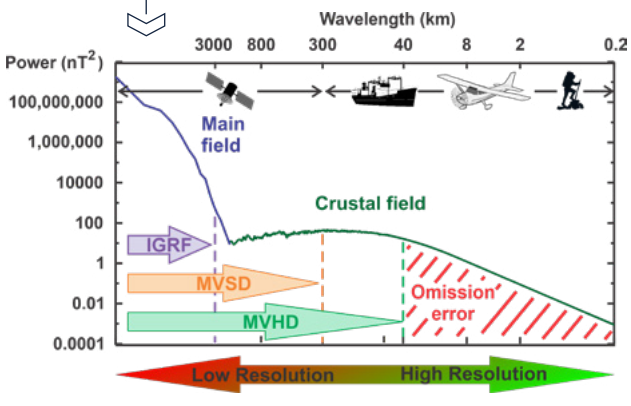
With directional drilling in today's market, well placement is of ever-increasing importance in the process of successfully drilling a well. Well placement by Measurements While Drilling (MWD) uses the direction of the Earth's gravity and magnetic field as a natural reference frame. For years, the industry standard used low resolution global models for this reference, such as the International Geomagnetic Reference Field (IGRF-13). These models only captured a fraction of the true complexity of the Earth's magnetic field, leading to inaccurate MWD corrections and consequently large uncertainties in the wellbore's final placement.



Large uncertainties in the final wellbore placement lead to many issues in the life cycle of the well. Improper placement can lead to a loss in reservoir production or collision issues with adjacent wells. To help reduce these uncertainties and help alleviate the issues posed by them, H&P recognized the need for higher resolution models of the Earth's magnetic field. Allowing for more accurate MWD corrections while drilling the well. To accomplish this, H&P offers a full suite of services to reduce this uncertainty so every customer has an option that meets their needs. One of those is highly accurate global geomagnetic reference models.

GLOBAL GEOMAGNETIC REFERENCE MODELS

H&P recognized the need for more accurate global geomagnetic reference models versus the industry standard. We also realize not every client has the same needs or budget. With that in mind, we produce the MagVAR Standard Definition Global Geomagnetic Model (MVSD) and the MagVAR High Definition Global Geomagnetic Model (MVHD).



The MVSD is a spherical harmonic model of the Earth's main field built from global magnetic data collected via satellites. H&P's modeling captures the Earth's main field and crustal anomalies as small as 300 km in size, making the MVSD a significant improvement over the industry standard IGRF model. The MVSD meets the conditions of the MWD tool code.

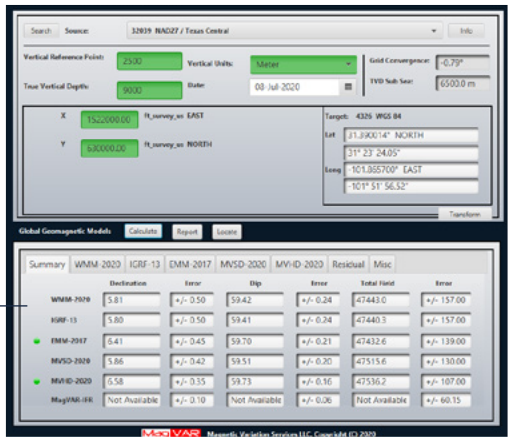
The MVHD is an ellipsoidal harmonic model built from global satellite magnetic data plus near-surface magnetic data sets. This allows the MVHD to capture the Earth's main field and crustal anomalies down to a resolution of 40 km. The increased resolution of the MVHD is a great solution compared to other models in the industry. The MVHD will satisfy the conditions of the MWD+HRGM tool code. The MVSD and MVHD models are updated annually to capture the secular changes to the magnetic field and implement modeling improvements.

REDUCE THE ELLIPSES OF UNCERTAINTY

By integrating the MVSD or MVHD models into your workflow you will reduce the Ellipses of Uncertainty (EOU). Our software now has the ability to use the MWD or MWD+HRGM tool codes when planning and drilling a well. Benefits include increased separation factors when anti-collision planning, reservoir production and safety.

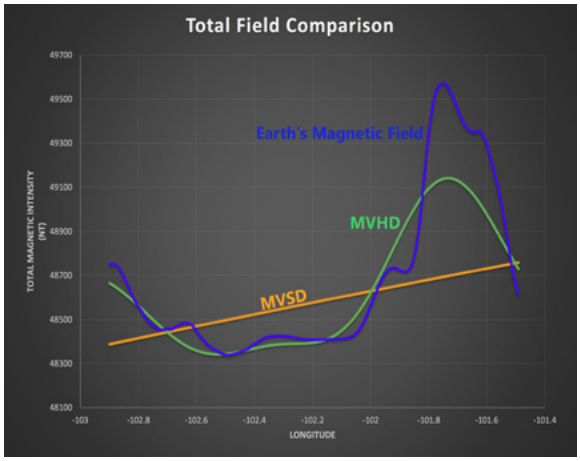
TOOL CODE	REFERENCE MODEL	APPROX EOU±
MWD + IGRF	IGRF	+10%
MWD	SD 0	% (STANDARD)
MWD + HRGM	HD	-10%

*Approximate values, actual EOU sizes depend on location and orientation of wellbore



EASE OF USE

H&P delivers each model with our global calculator. A user-friendly interface used to extract single or multiple points along a well path file from either MVSD or MVHD at your chosen date. H&P can also make the models available as a plug-in for your well planning or directional drilling software of choice, making this a seamless integration to your workflow.



PROOF IN THE FLIGHT LINE

At H&P, we compare our MVSD and MVHD models to proprietary high-resolution aeromagnetic surveys. By doing this, we provide proof in our modeling.

These surveys represent Earth's true magnetic field. As seen above, the MVSD model captures the overall trend of the Earth's main field. The higher resolution MVHD model begins to include some of the high-resolution features in the Earth's magnetic field generated by the crustal component.

ADDITIONAL ADD ON SERVICES

At H&P, we also offer add on services that can further reduce uncertainty when using MVSD or MVHD.

- Advanced MWD Analytics: method for reducing MWD survey error through least squares regression techniques
- Sag: method of correcting bottom hole assembly (BHA) Sag misalignment
- IFR Pad Solution (IFR-PS): IFR-1 level corrections based off local correction applied to MVHD from groundshots taken on pad

CONTACT US TODAY.

INDUSTRY EXPERTS ARE ALWAYS A PHONE CALL AWAY TO ANSWER ANY MVSD OR MVHD QUESTIONS YOU HAVE.

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