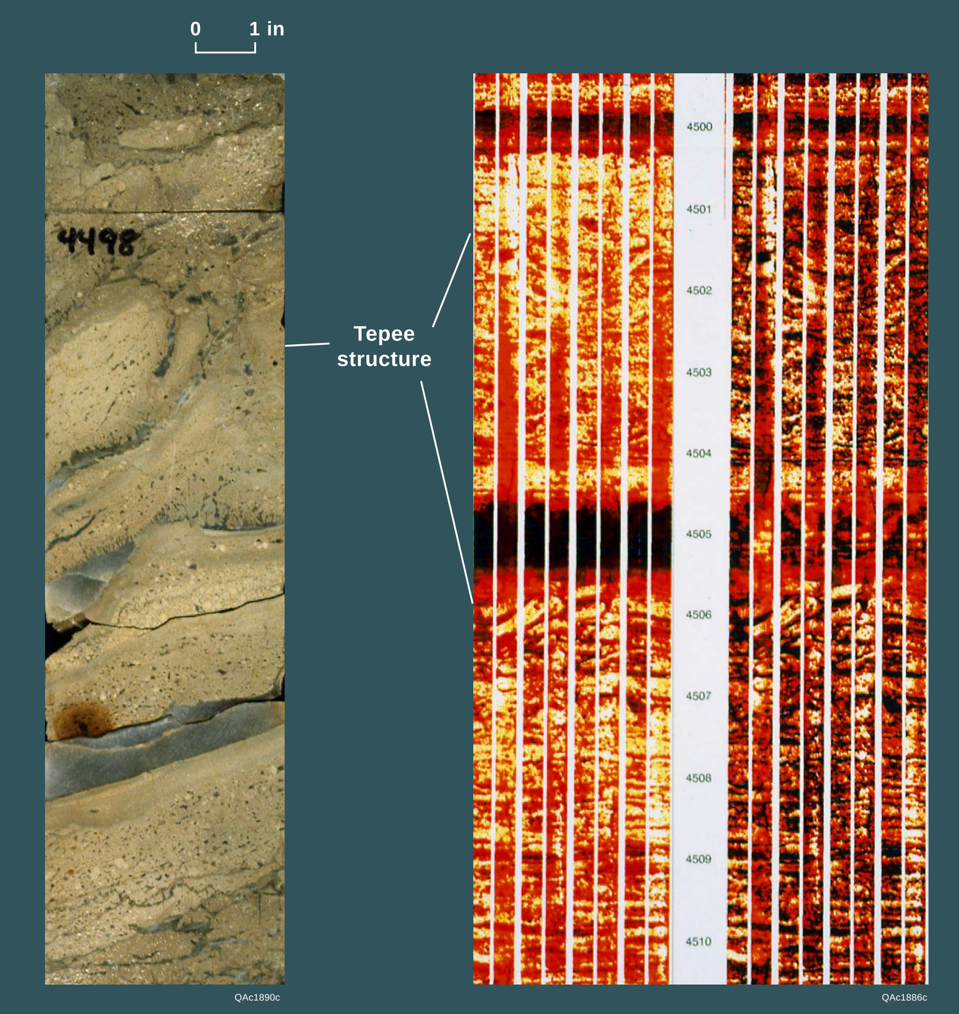
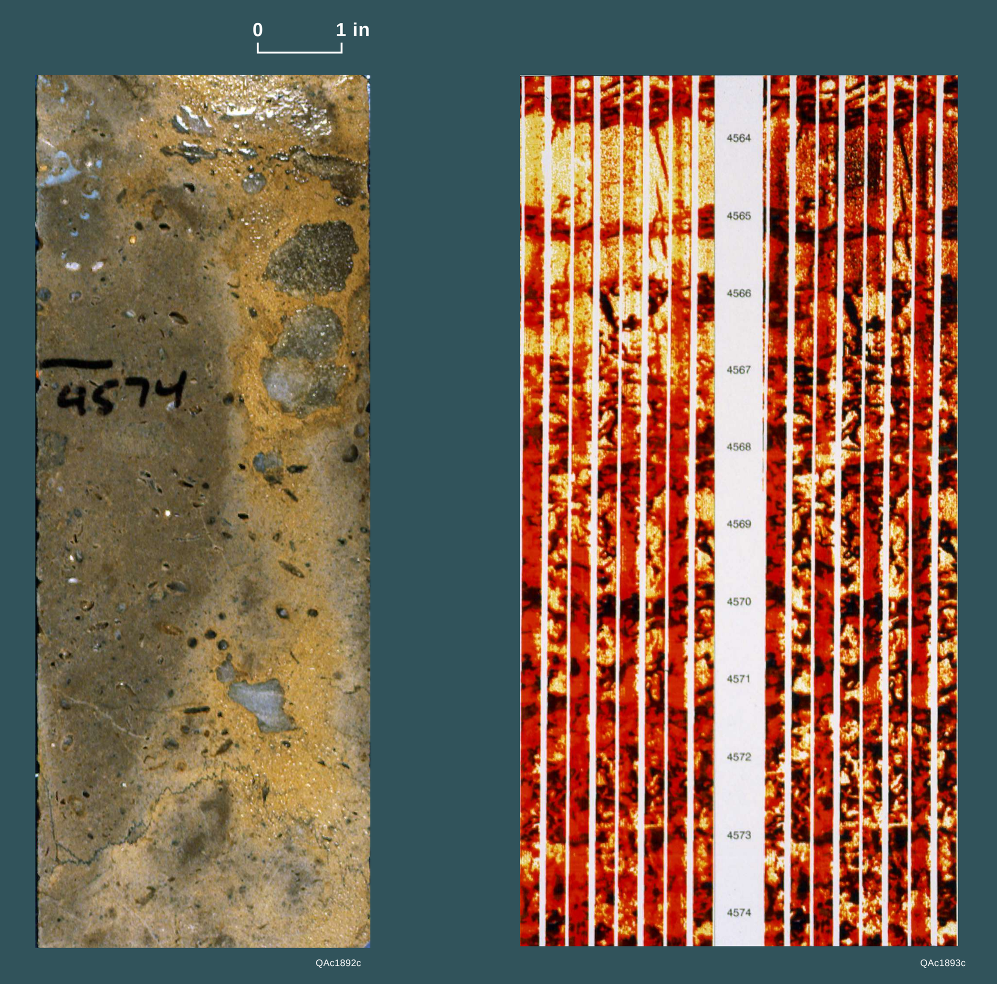
WIRELINE LOG-BASED IDENTIFICATION OF FACIES AND THE MID-SAN ANDRES UNCONFORMITY

Although cores provide the best data for characterization of facies, stratigraphy, and identification of the mid-San Andres unconformity, two wireline logs can supplement core data: borehole imaging logs and spectral gamma ray logs.



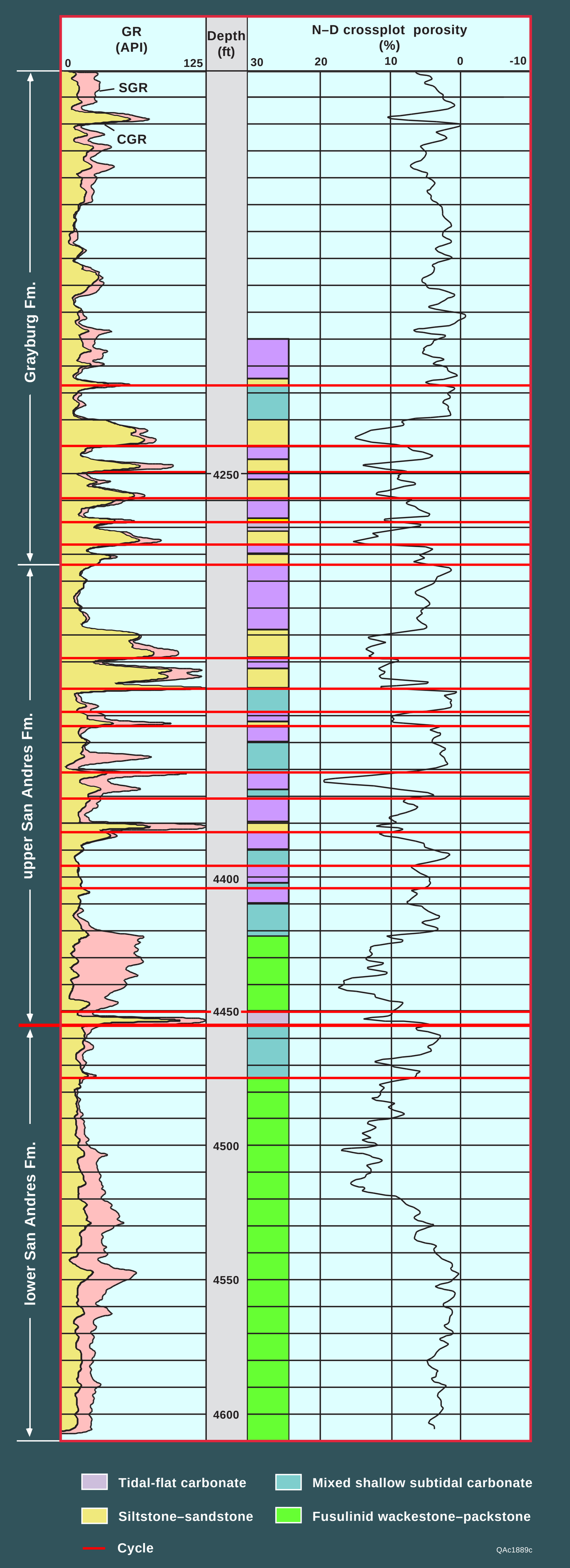
17. Paired core photograph and FMI log image: upper San Andres tidal-flat rocks. Tidal-flat facies are characterized on FMI by thin laminated character. Note tepee structure.



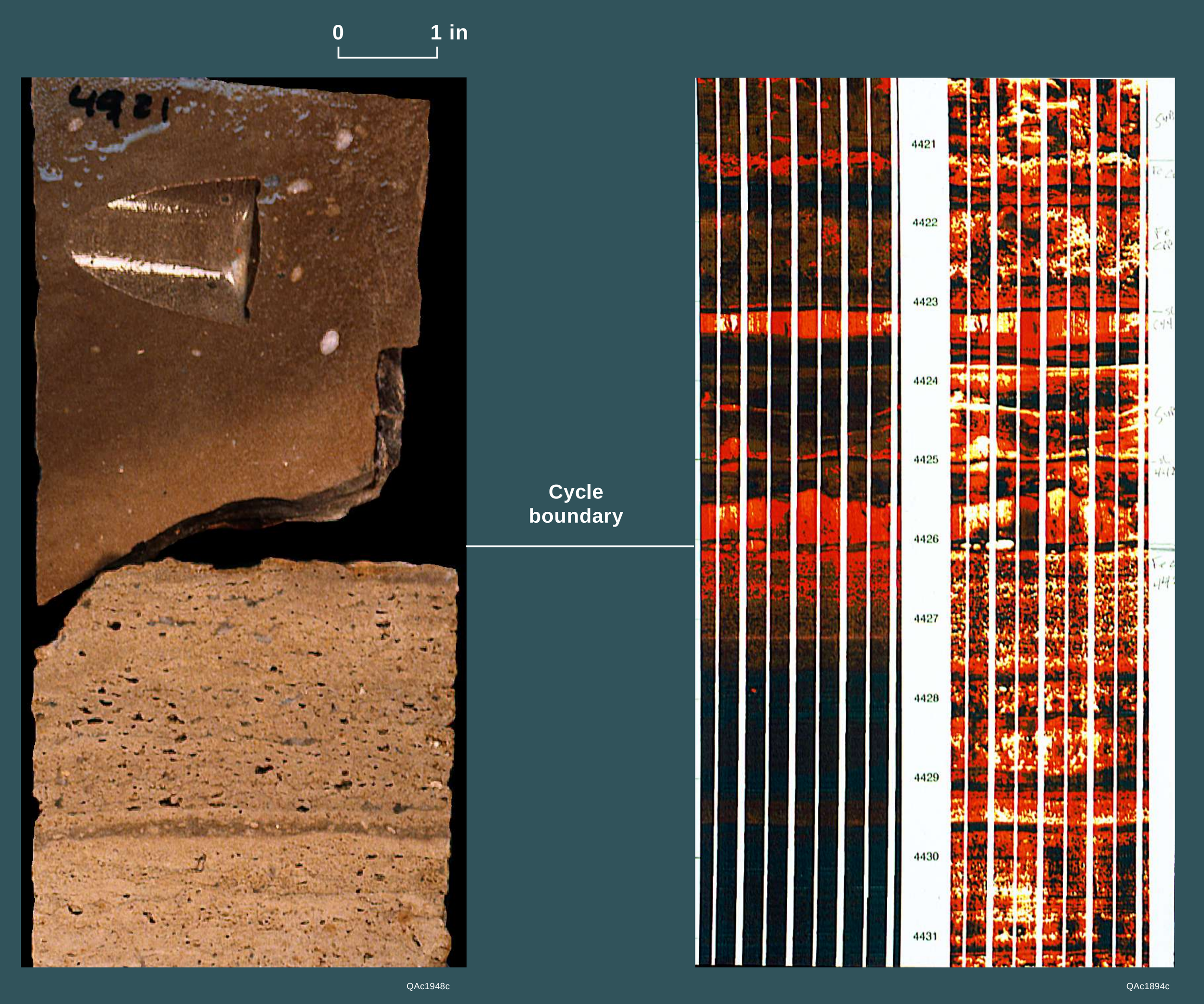
18. Paired core photograph and FMI log image: lower San Andres fusulinid facies. Fusulinid facies are characterized by vermiform FMI pattern.

FMI-BASED CORE DESCRIPTION

Arrow Fuhrman-Mascho Unit #307
Andrews County, Texas



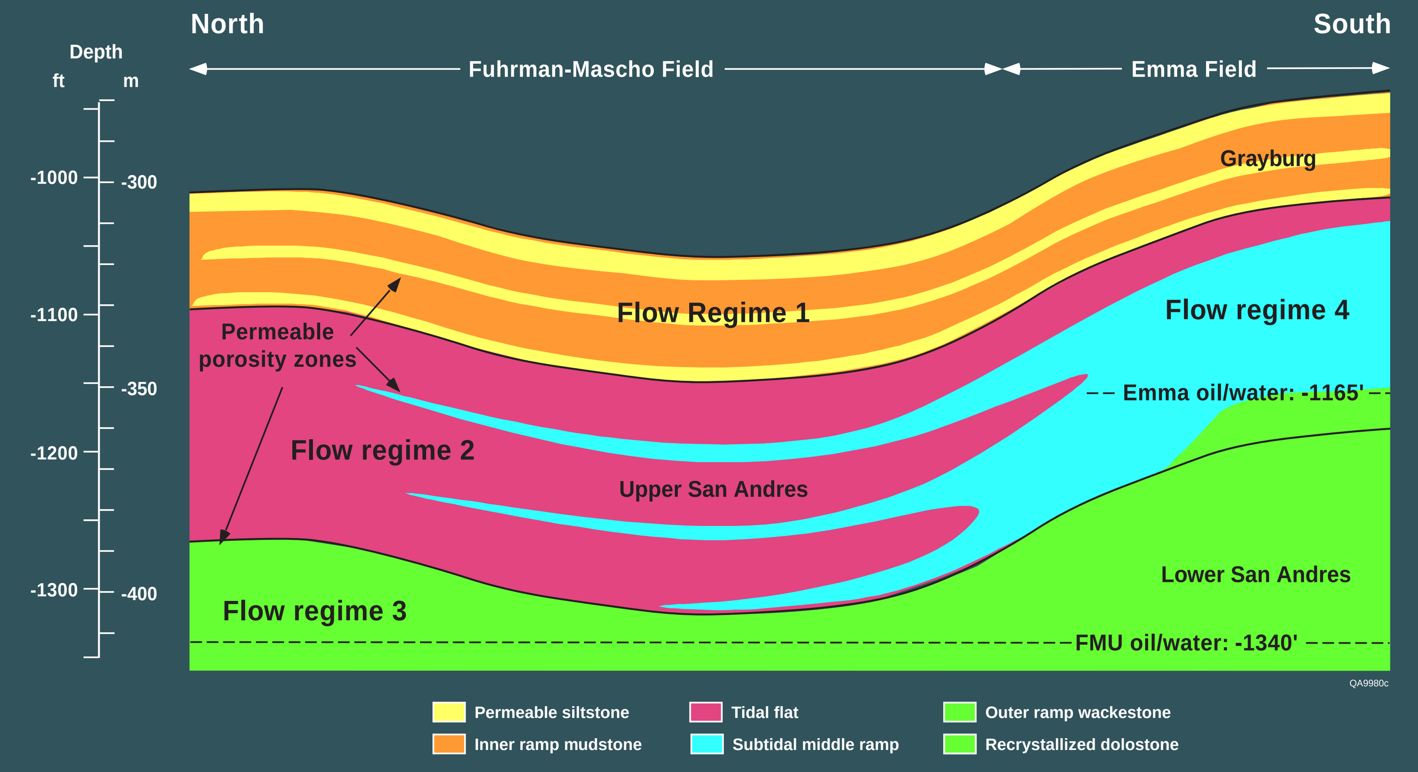
19. With proper core calibration, borehole imaging logs can provide high resolution information on facies type, rock fabrics, and fracture distribution. Vertical facies successions and cycle boundaries are easily definable for this well using the FMI, providing a basis for stratigraphic correlation and rock-fabric determination.



20. Paired core and FMI log image: upper San Andres. FMI has very high resolution that can be used to discriminate even the finest scale cycles and facies successions. Note: Core depths are about 5 ft higher than log.

IMPLICATIONS FOR TARGETING ADDITIONAL RECOVERY FROM THE SAN ANDRES FORMATION

PREDICTIVE MODEL OF HYDROCARBON DISTRIBUTION AND FLOW REGIME
San Andres-Grayburg Reservoirs, Andrews County Area



Flow Regime 1. Transgressive, high continuity siltstones; highly productive and floodable

Flow Regime 2. Inner ramp. low permeability carbonates; flow baffle; poor floodability

Flow Regime 3. Outer ramp, high continuity, permeable carbonates; floodable

Flow Regime 4. Middle ramp, permeable carbonate grainstones; highly productive and floodable

21. Although the upper San Andres is productive in many reservoirs in the Permian Basin, in inner platform settings like that of the Fuhrman-Mascho field area, the succession is dominated by low permeability, tidal-flat facies, and locally porous, cycle base subtidal facies. Although basal Grayburg siltstone/sandstone cycles are locally productive in these areas, the lower San Andres, because it consists of more stratiform and continuous, unconformity-related porosity, should be considered a primary target.

The potential of reservoirs developed at the lower San Andres unconformity may not have been realized throughout its extent. In Fuhrman-Mascho field, the lower San Andres is a major contributor to production as it is in the Means field to the north. Elsewhere it may have not been fully evaluated. In the nearby Emma field, for example, the reported oil/water contact is approximately 100 ft higher than it is in Fuhrman-Mascho. This may be a result of capillary effects associated only with the recrystallization below the mid-San Andres unconformity. The oil-water in Emma is placed in fusulinid wackestones of the upper San Andres that display low permeabilities and apparent high water saturations despite their moderate porosity. It is possible that the better rock fabrics in the lower San Andres may contain higher oil saturations than those in the upper San Andres despite their being some 100 ft below the apparent oil/water contact.

CONCLUSIONS

Regional outcrop and subsurface studies show that a major unconformity, caused by a major sea-level fall with accompanying nondeposition and possible erosion, separates upper and lower San Andres platform carbonate successions. Studies of the San Andres in the Fuhrman-Mascho area indicate that this unconformity is the locus of significant porosity and permeability development. The continuity of this unconformity porosity suggests that it should be a major target in reevaluating existing San Andres reservoir completions and in subregional exploration.

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