

## Catalytic Gas in Marine Shales

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Marine shales are considered passive containers in the decomposition of oil to gas because they show no catalytic activity whatsoever under ordinary laboratory conditions. We report here robust catalytic activity under anoxic conditions where rates of gas generation are accelerated by factors reaching over one million. Activity vanishes irreversibly with even brief exposures to oxygen, which may explain why this remarkable rock property has so successfully eluded detection until now. Measured activity is natural activity carried from the subsurface rather than artificial activity created under analytical conditions.

This is consistent with the observation that all activity can be extinguished with oxygen prior to analysis and with the fact that the reactions also proceed in pure helium under mild laboratory conditions (~ 200°C) without the addition of hydrogen. Activity is independent of rock maturity and geologic age, but increases sharply in rocks deposited in outer-neritic environments under anoxic conditions, conditions that favor the accumulation of transition metals. The catalytic nature of the reaction and its sensitivity to oxygen-poisoning implicates transition metals and our experiments with pure nickel support this possibility. Measured rock activities in the Mississippian Barnett Shale (Fort Worth Basin, Texas, USA) correlate with a regional trend of oil to dry gas from Montague County to Johnson County. That organic rich shales like the Barnett (Mississippian, Texas) and the Monterey (Miocene, California) generate catalytic gas under realistic conditions would suggest that they would similarly generate catalytic gas in the subsurface. The similarity between catalytic gas and produced gas in molecular composition and the association of high-activity shales with dry gas and low-activity shales with wet gas/oil would indicate that they do.