EXPLOITATION STRATEGIES FOR TIGHT GAS RESERVOIRS

Tight gas exploitation in British Columbia (and elsewhere in Canada) lags years behind the United States. The United States Geological Survey first assessed unconventional gas resources in 1995, and is currently producing updated descriptions and resource assessments by basin (Popov et al., 2001; Lang, 2002). The most recent Canadian resource assessment reports, by Stockmal et al (2001) and the Canadian Gas Potential Committee (2001), do not address unconventional gas plays, other than to acknowledge that they exist.

Advances in B.C. tight gas exploitation will occur in two areas: applying more varied exploration and exploitation strategies, and systematically using modern drilling and completions technologies.

EXPLORATION / EXPLOITATION STRATEGIES

Two major tight gas exploration and exploitation strategies account for most recent tight gas production increases in the United States, but have not been pursued systematically in Canada. Successful application of these strategies will require use of the advanced drilling and completion methods described below.

1. Pursuit of extremely thick basin-centered gas sandstones, with in-place gas resources ranging up to hundreds of BCF per section. Successful exploitation of these plays allows considerable downspacing and yields long-life reserves, thus improving project economics (see Lyle (2002), Norris and Phillips (2002), and Cumella et al. (2002)).

   Although the southern Deep Basin contains large areas of thick stacked tight gas sandstones, there has been no concerted effort to exploit these, as economic production rates have not been attained outside of reservoir sweet spots. Downspacing has been applied in selected cases in low- to moderate-permeability strata where economic flow rates can be attained (e.g. Cardium and Cadomin sands in the Alberta Deep Basin).

2. Detection and exploitation of natural fracture “sweet spots” in settings with little structural deformation. This approach has been described for Cretaceous reservoirs of the Piceance Basin by Decker and Klawitter (1994) and Cumella et al. (2002), and for the Frontier Formation in the Green River Basin (Krystinik, 2001). Hart and Teufel (2000) described the detection of high-permeability fracture swarms in Mesaverde Group sandstones of the San Juan Basin.

In British Columbia, natural fractures are pursued primarily in highly-deformed Foothills settings. However, more subtle fracture systems enhance productivity in the Jean Marie, and have been mapped in relation to deeper carbonate platform edges (McAdam, 1993; Reinson et al., 1993). Intensive mapping of fracture trends, such as described by Hart and Teufel (2000), may yield sweet spots in other B.C. tight gas reservoirs.

MODERN DRILLING AND COMPLETION TECHNOLOGY

Advances in drilling and completion methods allow operators to drill wells with much less formation damage, and to stimulate tight zones more successfully.

1. Directional and horizontal drilling – This has become a relatively common approach in exploiting tight gas reservoirs. Horizontal wells can open up long sections of marginal-quality reservoir, access stratigraphic sweet spots more readily, intersect large numbers of natural fractures with near-vertical orientations, and drain larger areas.

   Directional drilling is now commonly used in B.C. to exploit fractured Foothills reservoirs, such as the Pardonet/Baldonnel. Horizontal wells are responsible for making much of the Jean Marie reservoir economic, and are also used in the linear fold belt play trend for the Baldonnel and other reservoirs. The NEB et al. (2000) analyzed horizontal well performance for selected plays in B.C., and demonstrated its economic value in most applications attempted to date.

2. Underbalanced drilling – This is another drilling strategy that has become relatively commonplace, and is often used in tandem with directional and horizontal drilling. Low-density drilling fluids, employing hydrocarbons, foams, emulsions, and air, are designed to prevent extensive filtrate invasion of reservoirs, thus avoiding or reducing formation damage.

   EnCana has used inert nitrogen foam in wells with 1000 metre horizontal legs to access Jean Marie gas in its Greater Sierra play area (Daily Oil Bulletin, 03/01/15).

3. Advanced Fracture Stimulation – Sophisticated fracture stimulation jobs are the key to making many tight gas targets flow at economic rates. Lyle (2002) detailed the evolution of frac jobs in the Lance and Fort Union sandstones at Jonah Field in Wyoming. Fluids, proppants, timing and placement are all important issues in ensuring successful, long-lived reservoir stimulations.

As EnCana has been involved in much of this work in the U.S. Rocky Mountains, the technology will likely be applied more extensively in western Canada in the near future. Other U.S.-based operators, such as Burlington Resources, have stated their intention to apply U.S. tight gas technology to Canada's tight gas sands; fracture stimulations are an obvious area of interest.