Grades and Types of Crudes
from the Western Canadian Sedimentary Basin

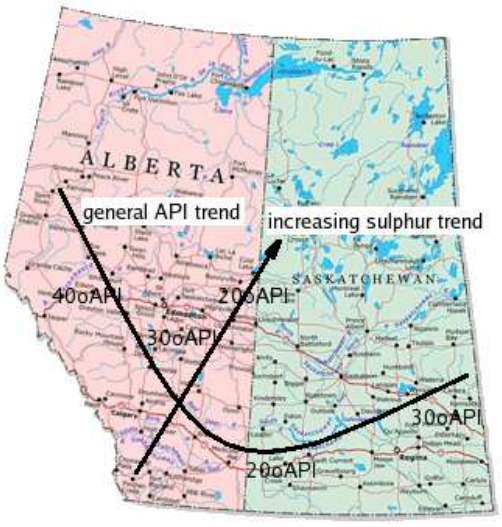
This document is not meant to be a definitive reference for the subject, but rather a general guide to the various grades and types of crude oil streams that are available from the Western Canadian Sedimentary Basin at a casual or introductory level.

There is, simply stated, a complete “rainbow” of crude grades produced from the Western Canadian Sedimentary Basin (WCSB). The crude collection system in the WCSB is primarily a common carrier system, which allows various grades of crudes to commingle into aggregate streams. These aggregate streams compose the vast majority of the commercial commodity transactions, though in some cases individual components of aggregate streams are available as separate entities. Though the number is transitory, Enbridge Pipelines has stated in the past that there are some 90 commercial products shipped through its system from the WCSB (assumed to include refined products and NGL's, but still a large number). Other pipeline transportation systems delivering WCSB crudes have like numbers of commodities proportional to their delivered volumes.

Industry has used labels, and in some cases specifications, to group crude grades into light, medium, heavy, sweet, and sour. Not all parties follow the same conventions on what constitutes light, medium and heavy. Some subgroupings are present such as high and low TAN variants of heavy sour crudes. Proximity to common carrier pipelines, equalization systems (similar in operation to the US gravity and sulphur banks) and other business factors are used to determine the ultimate destination of wellhead production. In general, the WCSB grades (and example streams in parentheses) could be described as follows,

1) condensate (CRW)
2) synthetic crude (OSA, SYN, SSB, HSB)
3) light sweet crude (Rainbow, Federated, Peace, Mixed Sweet Blend aka MSW)
4) light sour crude (Light Sour Blend aka LSB)
5) medium sweet crude ()
6) medium sour crude (Midale, MSO)
7) heavy sour crude (Bow River, Lloyd blends, bitumen blends, WCS)

Looking at a map of western Canada in very general terms, there is a light-medium-heavy-medium-light “arc” running west to east across the WCSB (“heavy” most predominant at the Alberta—Saskatchewan border). There is also a less rigid sweet-sour transition from the southwest to northeast. Though these trends are not exact, a crude from southwestern Alberta or southeastern Saskatchewan will most likely be lighter and sweeter than one from northeastern Alberta or northwestern Saskatchewan.



More specifically, these grades can be very generally described in the following pages.

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Condensate (density ~725 kg/m3, 63oAPI, sulphur ~0.2 wt%)
Condensate is a general term used to describe a material also known as gas condensate, pentanes plus (C5+), or natural gasoline generated from the WCSB gas field production[1], though it may also contain processed streams that meet the "like and kind" of gas condensate. Only a small proportion of produced condensate leaves the WCSB as a "neat stream" – the primary disposition of condensate is as a diluent[2] into heavy crude and bitumen[3] production. Condensate is used as a "thinner" to modify the viscosity and density of the heavy crudes and bitumen to meet pipeline specifications for the blended products. There has been, and is, an equalization system in place for WCSB condensate that penalizes atypical streams entering the pool, effectively stabilizing product quality through commercial means.

Synthetic Crudes (density ~860 – 870 kg/m3, 31 – 33oAPI, sulphur typically <0.2 wt%)
The classic definition of synthetic crude[4] is a combination of hydrocarbon streams produced from upgrading a crude bitumen. WCSB synthetic crudes are typically blends of naphtha, distillate, and gas oil streams collected during the upgrading process. Synthetic crudes are unlike other crude streams in that they typically, through the upgrading and blending processes, contain no residuum[5]. The design of the upgrader will be the most influential factor in the composition of synthetic crudes.

Upgrading flexibilities can and have been utilized to produce hydrotreated and non-hydrotreated naphtha, distillate, and/or gas oil streams which are blended to form various combinations of ultra-sweet, sweet, and sour streams. In all cases, classification as a "synthetic crude" seems to require the absence of residuum.

Synthetic crudes can and have been used as diluent in the production of bitumen based heavy sour crudes. The combination of synthetic crudes and bitumen are called "synbit" and are described later.

Light Sweet Crudes (density ~830 kg/m3, 39oAPI, sulphur <0.5 wt%)
WCSB light sweet crudes are typically benchmarked against, and directly compared with, WTI (West Texas Intermediate). The largest volumes of light sweet crudes are produced in a broad foothills region of the Canadian Rocky Mountains, and are transported through commingled pipelines to Edmonton, Alberta. Light sweet crude streams are available individually for westward delivery from Edmonton, and as a commingled stream (MSW) for eastward and southward delivery from Edmonton. Smaller localized volumes of light sweet production are extracted in the Northwest Territories, British Columbia, Saskatchewan, and Manitoba. In most cases these production streams are blended into the MSW stream.

Light sweet crudes can and have been used as diluent in the production of bitumen based heavy sour crudes. The combination of light sweet crudes and bitumen bears no name distinction since they are crude oil–crude oil combinations. There has been, and is, an equalization system in place for light sweet crudes that penalizes atypical streams entering the pool, effectively stabilizing product quality through

1 Canada is the third largest producer of natural gas in the world, though not all of the natural gas produced in the WCSB has associated liquids that qualify as gas condensate
2 a) A fluid used to thin out or weaken another fluid, also known as a solvent. b) A hydrocarbon substance used to dilute crude bitumen so that it can be transported by pipeline
3 A sticky, tar-like form of crude oil which is so thick and heavy that it must be heated or diluted before it will flow
4 "Syncrude" is the name of a business operating in Alberta, and is not used locally as an abbreviation of synthetic crude
5 Hydrocarbon molecules having boiling points generally above 1000°F or 538°C

commercial means.

Light Sour Crudes(density ~850 – 860 kg/m3, ~34oAPI, sulphur ~1.0 – 1.5 wt%)
WCSB light sour crudes are typically benchmarked against, and directly compared with, WTS (West Texas Sour). For the most part, WCSB light sour crudes are produced from regions to the east of their light sweet counterparts. The volumetrically largest light sour stream is Light Sour Blend (LSB), produced by combining predominantly southeastern Saskatchewan production (SES) and other streams from central Alberta including, but not limited to, Central (aka Koch) Alberta (CAL, KAL), Sour Peace River (SPR), Sour Light Edmonton blend (SLE)).

Medium Sweet Crudes (density ~880 – 890 kg/m3, ~30oAPI, sulphur <0.5 wt%)
There are some, though not many, medium sweet streams available from the WCSB. Typically these small volume streams are blended into other commingled streams based on proximity connections and financial considerations.

Medium Sour Crudes
Medium sour crudes from the WCSB are typically 885 – 890 kg/m3 density (~ 30°API) and 2.0 wt% sulphur. Examples of medium sour streams of commercial significance include Midale (M, MSM) and Mixed Sour (MSO or SO) which is a varying combination of Gibson Sour (SOG) plus Sour High Edmonton (SHE) along with, on occasion, other smaller miscellaneous "like" streams.

Heavy Sour Crude (density 925 – 940 kg/m3, ~20oAPI, sulphur 2.9 – 3.6 wt%)
This is the largest classification, and the most volumetrically significant, group of crude products from the WCSB. To some extent, all of the crude streams in this classification are blended products. Heavy Sour crudes include conventionally produced heavy crude (rod and screw pump production), Cyclic Steam Stimulation[6] bitumen production, SAGD[7] production, and mined oil sands[8] containing bitumen. Within the heavy sour crude classification, there are dilbits (diluent—bitumen combinations where the diluent is nearly always condensate), synbits (synthetic crude—bitumen combinations where the diluent is synthetic crude), and dilsynbits (diluent— synthetic crude—bitumen combinations). Examples of conventional heavy include Lloydminster crudes (LLB, LLK, Bow River, among others). Examples of dilbits include Cold Lake (CL), Wabasca Heavy (WH), Peace Heavy (PH), among others. Examples of synbits include Christina Lake (CSB), Mackay River Heavy (MKH), Borealis Heavy Blend (BHB), among others. Examples of dilsynbits include Western Canadian Select (WCS), DilSynBit (DSB), among others.

6 Cyclic Steam Stimulation (CSS) involves injection of high-pressure steam for 1-2 months to heat the formation. Injection is then discontinued briefly for 4 or more months. The bitumen seeps back to the injection wells, which now become production wells operated by pumping

7 Steam Assisted Gravity Drainage – two horizontal wells separated by a vertical distance are placed near the bottom of the formation. The top horizontal well is used to inject steam, which rises forming a large steam chamber above the well, and the bottom well is used to collect the produced liquids (formation water, condensate, and oil). The rising steam condenses on the boundary of the chamber, heating and entraining the oil to the production well. The process leads to a high recovery and high oil rate at economic oil-to-steam ratios (OSR).

8 oil sand or bituminous sand, is a combination of clay, sand, water, and bitumen. Oil sands are mined for the oil rich bitumen which is refined into oil. Conventional oil is extracted by drilling traditional wells into the ground whereas tar sand deposits are mined using truck and shovel techniques. On average bitumen contains 83.2% carbon, 10.4% hydrogen, 0.94% oxygen, 0.36% nitrogen and 4.8% sulphur.