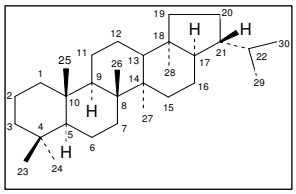
Norhopanes

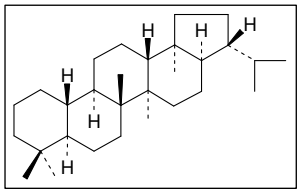
Pentacyclic triterpanes of the hopane type are ubiquitous constituents of sedimentary organic matter. Crude oils and mature sediments usually contain a predominance of hopanes with 17α(H),21β(H)-skeletal configurations.[1] However, a number of rearranged (Biomarker Focus 35), demethylated hopanes (Norhopanes) and methylated hopanes are present in diagnostic quantities for geochemical and oil spill (environmental forensics) applications. A related, but less common, group of hopanes with n-alkane side chain (the 30-nor series) is also widely distributed.[2,3,4]

25-Norhopanes

The 25-norhopanes is a series of C_{26}-C_{34} compounds that are related to the normal hopanes. Their origin is a topic of dispute, microbial production or microbial demethylation. 25-Norhopane elutes between αß+ßα Bisnorhopanes (Cat. No. **2637.28** and Cat. No. **2636.28**) and 29αß (Cat. No. **1321.29**).



Cat. No. 0132.30
17α(H),21β(H)-Hopane
(30αβ)

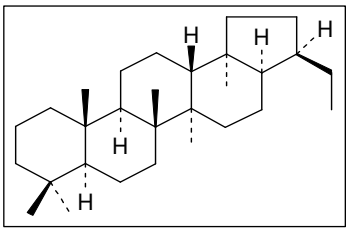


Cat.No. 2638.29
17α(H),21ß(H)-25-Norhopane
(25Nor)

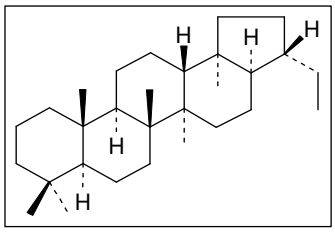
30-Norhopanes

The 30-norhopanes is a series of hopanes with one less methyl group in the sidechain than the hopanes. They are widely distributed in sediments and oils. The dominant member in mature sediments is the 17α(H),21ß(H)-30-norhopane (29αß, Cat. No. **1321.29**), but the series ranges from C_{29} to C_{34}. [2,3,4]

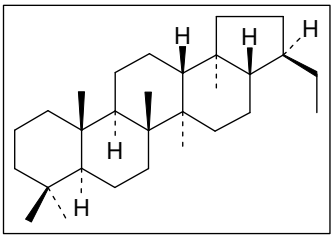
All four isomers of the C_{29} 30-norhopanes are available as standards from Chiron.



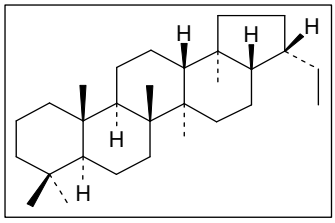
Cat.No. 1367.29
17α(H),21α(H)-30-Norhopane (29αα)



Cat.No.1321.29
17α(H),21ß(H)-30-Norhopane (29αß)



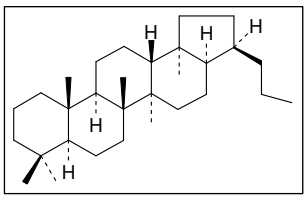
Cat.No. 0614.29
17ß(H),21α(H)-30-Norhopane (29ßα)



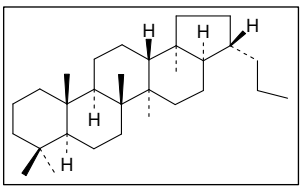
Cat.No. 2640.29
17ß(H),21ß(H)-30-Norhopane (29ßß)

C_{30} 30-Normethylhopanes

This group is the lowest of the normal normethylhomohopane series. Chiron offers the 29nor30αα and 29nor30αβ isomers. The αβ-isomer elutes just after the most abundant C_{30}-hopane, the 17α(H),21β(H)-hopane (Cat. No. **0132.30**). The αα-isomer elutes between 17α(H),21β(H)-hopane (30αß, Cat. No. **0132.30** and gammacerane (Cat. No. **2646.30**).[1,3-5]



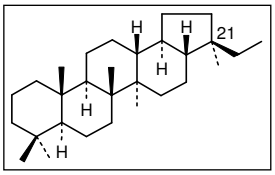
Cat.No. 2179.30
17α(H),21α(H)-30-Nor-29-methylhopane
(29nor30αα)



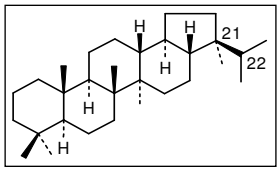
Cat.No. 2262.30
17α(H),21β(H)-30-Nor-29-methylhopane
(29nor30αß)

Rearranged norhopanes: Nor-spergulanes

A new series of rearranged hopanes ranging from C_{29} to C_{34} has recently been identified as 28-*nor*-spergulanes (or 21-methyl-28-nor-hopanes). The C_{29} member of the series was unambiguously identified as 17ß(H),18α(H)-28-*nor*-spergulane (29Nsp, Cat. No. **2883.29**) by NMR-spectroscopy.[6] 29Nsp elutes midway between C_{30} 17α-diahopane (30Dia or C_{30}*, Cat. No. **2886.30**) and 17ß,21α-30-norhopane (29αß, Cat. No. **1321.29**). The C_{29} 28-*nor*-spergulane (29Nsp) is always the dominant member of the series and can be detected in most crude oils or mature sediments using GC-MS. Their content is generally high in samples having high amounts of rearranged hopanes (diahopanes and neohopanes). 29Nsp seems to be particularly abundant in some oils from lacustrine source rocks in South East Asia.



Cat. No. 2883.29
17ß(H),18α(H)-28-*Nor*-spergulane
(29Nsp)

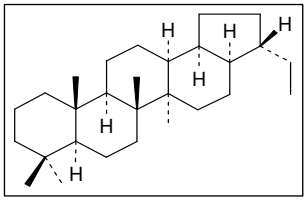


Cat. No. 2884.30
17ß(H),18α(H)-22-Methyl-28-*nor*-spergulane
(30Nsp)

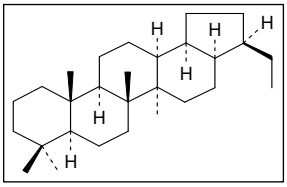
Bisnorhopanes

28,30-Bisnorhopanes (BNH)

Bisnorhopanes are diagnostic hopanes both in geochemical analysis and in oil spill analysis. The structure of 17α(H),21ß(H)-28,30-bisnorhopane (Cat. No. **2637.28**) was established by Seifert et al. by X-ray crystallography after isolation from Monterey shale.[7] This compound co-elutes with the 28ßα isomer (Cat. No. **2636.28**) under standard GC conditions and misidentification is possible since both isomers are present in petroleum. They are distinguished by liquid chromatography, as the 28ßα isomer is a lot more retained on certain C_{18} HPLC columns. The 28ßß-isomer is stable within the oil-generation window, and occurs in smaller amounts.



Cat.No. 2637.28
17α(H),18α(H),21ß(H)-28,30-Bisnorhopane
(28αß or BNH)



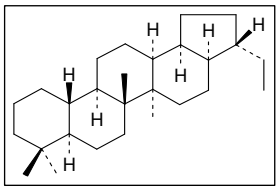
Cat. No. 2636.28
17ß(H),18α(H),21α(H)-28,30-Bisnorhopane
(28ßα or BNH)

Trisnorhopanes

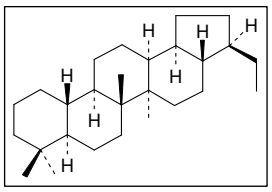
25,28,30-Trisnorhopanes (TNH)

TNH are formed by biodegradation from BNH. TNH isomers are diagnostic hopanes both in geochemical and oil spill analysis. Three isomers are present in petroleum, and all are available as identification standards from Chiron. As for the bisnorhopanes, 28αß and the 28ßα are present in largest quantities. The 28ßß-isomer is stable within the oil-generation window, and occurs in smaller amounts.

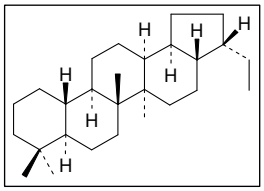
25nor28αß (Cat. No. **2632.27**) and 25nor28ßα (Cat. No. **2634.27**) elutes between Ts (Cat. No.**2635.27**) and Tm (Cat. No. **0615.27**) while 25nor28ßß (Cat. No. **2633.27**) elutes just after Tm.



Cat.No. 2634.27
17α(H),18α(H),21ß(H)-25,28,30-Trisnorhopane
(25nor28αß (TNH))



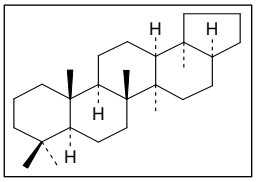
Cat.No. 2632.27
17ß(H),18α(H),21α(H)-25,28,30-Trisnorhopane
(25nor28ßα (TNH))



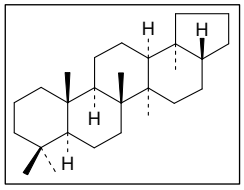
Cat.No. 2633.27
17ß(H),18α(H),21ß(H)-25,28,30-Trisnorhopane
(25nor28ßß)

22,29,30-Trisnorhopane (Tm)

Tm elutes after Ts and in front of 29Diahopane. 17α(H)-22,29,30-Trisnorhopane (Tm) is more stable than 17ß(H)-22,29,30-Trisnorhopane (ßTm) and is the dominant of the two in more mature sediments. However, ßTm is relatively more stable than hopane (30ßß or 17ß(H),21ß(H)-hopane, **Cat. No. 0613.30**), but less stable than moretane (30ßα or 17ß(H),21α(H)-hopane, **Cat. No. 0612.30**).



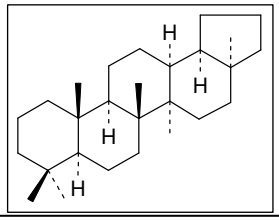
Cat.No. 0615.27
17α(H)-22,29,30-Trisnorhopane (Tm)



Cat.No. 2639.27
17ß(H)-22,29,30-Trisnorhopane (ßTm)

22,29,30-Trisnorneohopane (Ts)

Ts/(Ts+Tm)[5]: 27Ts (Cat. No. **2635.27**) is more stable than the non-rearranged Tm (17α(H)-22,29,30-trisnorneohopane, Cat. No. **0615.27**), and thus the ratio Ts/(Ts+Tm) (sometimes reported as Ts/Tm) is a much used maturity parameter. The ratio may also relate to the source as it is not clear whether the conversion Tm to Ts occur. The ratio should be used with caution, and reference standards are required. Tm and Ts commonly co-elute with tricyclic or tetracyclic terpanes on the *m/z* 191 mass chromatogram.



Cat.No. 2635.27
18α(H)-22,29,30-Trisnorneohopane
Ts (27Ts)

Oil Spill Identification / Environmental Forensics

Biomarkers play an important role in oil spill identification, and certain norhopanes are frequently used as diagnostic markers.[8-11] In articles on oil spill identification one often see that a different code is used for the hopane biomarkers as used in the geochemical literature. Please see BMF 19 regarding Oil Spill Analysis.

Frequently used Diagnostic Oil Spill Ratios related to norhopanes:

	Code used here	*Code used in ref. 11*
18α(H)-Trisnorneohopane/17α(H)-Trisnorhopane	Ts/Tm	Ts/Tm
28,30-Bisnorhopane (BNH)/C_{30} αß-hopane	(28αß+28ßα)/30αß	H28/H30
C_{29} αß25-Norhopane/C_{30} αß-hopane	25nor/30αß	NOR25H/H30
C_{29} αß30-Norhopane/C_{30} αß-hopane	29αß/30αß	H29/H30

Standards available from Chiron

- 1-5 µg quantities are supplied in convenient 300µL GC-vials for dilution to e.g. 50-100µg/mL
- Quantities are measured relative to the intencity (TIC) of the 30αß hopane or by gravimetry
- The purity is generally 95%+, but in some instances it is a mixture with other hopane biomarkers.

2634.27	17α(H),18α(H),21ß(H)-25,28,30-Trisnorhopane (TNH), purity 45%	25nor28αß	ca. 5 µg
0615.27	17α(H)-22,29,30-Trisnorhopane	Tm	100 µg/mL*
2639.27	17ß(H)-22,29,30-Trisnorhopane, purity 55%	ßTm	ca. 5 µg
2637.28	17α(H),18α(H),21ß(H)-28,30-Bisnorhopane (BNH)	28αß	ca. 1 µg
2636.28	17ß(H),18α(H),21α(H)-28,30-Bisnorhopane (BNH), purity 90%	28ßα	ca. 5 µg
2638.29	17α(H),21ß(H)-25-Norhopane , purity 48%	25Nor	ca. 5 µg
0614.29	17ß(H),21α(H)-30-Norhopane (Isoadiantane), purity 86%	29ßα	100 µg/mL*
1321.29	17α(H),21ß(H)-30-Norhopane	29αß	50 µg/mL*
1367.29	17α(H),21α(H)-30-Norhopane	29αα	50 µg/mL*
2640.29	17α(H),21ß(H)-30-Norhopane, purity 88%	29ßß	ca. 5 µg
2883.29	17ß(H),18α(H)-28-*Nor*-spergulane	29Nsp	ca. 5 µg
2884.30	17ß(H),18α(H)-22-Methyl-28-*nor*-spergulane	30Nsp	ca. 5 µg
2179.30	17α(H),21α(H)-30-*Nor*-29-methylhopane	29nor30αα	50 µg/mL*
2262.30	17α(H),21β(H)-30-*Nor*-29-methylhopane	29nor30αß	50 µg/mL*

* In isooctane

Purities of all compounds are >95% unless otherwise stated.

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