

ESCOLA UNIVERSITÀRIA POLITÈCNICA DE MANRESA

Departament d'Enginyeria Minera i Recursos Naturals

**ESTUDI DELS MARCADORS
BIOMARCADORS DE CONQUES
ALTAMENT REDUCTORES**

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- CRANWELL, P.A. (1986) Esters of acyclic and polycyclic isoprenoid alcohols: biochemical markers in lacustrine sediments. *Org. Geochem.* **10**, 891-896.
- CRANWELL, P.A. (1988) Lipid geochemistry of late Pleistocene lacustrine sediments from Burlan, Cheshire, U.K. *Chem. Geol.* **68**, 181-197.
- CRANWELL, P.A., CREIGHTON, M.E. i JAWORSKI, G.H.M. (1988) Lipids of four species of freshwater chrysophytes. *Phytochem.* **27**, 1053-1059.
- CRANWELL, P.A., EGLINTON, G. i ROBINSON, N. (1987) Lipids of aquatic organisms as potential contributors to lacustrine sediments-II. *Org. Geochem.* **11**, 513-527.
- CUNY, P., GROSSI, V. i RONTANI, J.F. (1997) Identification of a "pool" of lipid photoproducts in senescent phytoplankton cells. A *Organic Geochemistry*. 18th International Meeting on Organic Geochemistry, Maastricht, The Netherlands, 22-26 September, 1997. Abstracts Part I, pp. 433-434. Forschungszentrum Jülich, Alemania.
- DAHL, J., MOLDOWAN, J.M., MCCAFFREY, M.A. i LIPTON, P.A. (1992) A new class of natural products revealed by 3 β -alkyl steranes in petroleum. *Nature* **355**, 154-157.
- DAHL, J., MOLDOWAN, J.M., SUMMONS, R.E., MCCAFFREY, M.A., LIPTON, P., WATT, D.S. i HOPE, J.M. (1995) Extended 3 β -alkyl steranes and 3-alkyl triaromatic steroids in crude oils and rock extracts. *Geochim. Cosmochim. Acta* **59**, 3717-3729.
- DANY, F., RIOLO, J., TRENDEL, J.M. i ALBRECHT, P. (1990) 3 β -Carboxysteranes, a Novel Family of Fossil Steroids. *J. Chem. Soc., Chem. Commun.* 1228-1230.
- DAS, B. i SRINIVAS, K.V.N.S. (1992) Minor C₂₉-steroids from the marine red alga, *Gracilaria edulis*. *Phytochem.* **31**, 2427-2429.
- DASTILLUNG, M. (1976) Lipides de sédiments récents. Ph. D. Thesis. Université Louis Pasteur, Estrasburg.
- DASTILLUNG, M., ALBRECHT, P. i OURISSON, G. (1980a) Alcools Aliphatiques et Polycycliques dans les Sediments Alcools Derives du Hopane et du 3-Methyl Hopane. *J. Chem. Res.* 2353-2374.
- DASTILLUNG, M., ALBRECHT, P. i OURISSON, G. (1980b) Aliphatic and Polycyclic Alcohols in Sediments: Hydroxylated Derivatives of Hopane and of 3-Methylhopane. *J. Chem. Res. S*, 168-169.
- DASTILLUNG, M., ALBRECHT, P. i OURISSON, G. (1980c) Aliphatic and Polycyclic Ketones in Sediments. C₂₇ - C₃₅ Ketones and Aldehydes of the Hopane Series. *J. Chem. Res S*: 166-167.

- DE GRAAF, W., SINNINGHE DAMSTÉ, J.S. i DE LEEUW, J.W. (1992) Laboratori simulation of natural sulphurization: I. Formation of monomeric and oligomeric isoprenoid polysulphides by low-temperature reactions of inorganic polysulphides with phytol and phytadienes. *Geochim. Cosmochim. Acta* **56**, 4321-4328.
- DEHMER, J. (1989) Petrographical and organic geochemical investigation of the Oberpfalz brown coal deposit, West Germany. *Int. J. Coal Geol.* **11**, 273-290.
- DEHMER, J. (1995) Petrological and organic geochemical investigation of recent peats with known environments of deposition. *Int. J. Coal Geol.* **28**, 111-138.
- DE LAS HERAS, F. X. (1989) Geoquímica orgànica de conques lacustres fòssils. Tesi Doctoral, Universitat de Barcelona.
- DE LAS HERAS, F. X., DE REQUESENS, E., DE LAS HERAS, A.M. i BERÀSTEGUI, X. (1993b) Organic geochemistry of Cretaceous marine basin source rocks (Organyà, Catalonia). A *Organic Geochemistry. Poster Sessions from the 16th International Meeting on Organic Geochemistry*, Stavanger, Noruega, 22-24 September, 1993 (Editat per Øygard K.), pp. 131-135. Falch Hurtigtrykk, Oslo.
- DE LAS HERAS, F. X., GRIMALT, J.O., CABRERA, L. i SÀEZ, A. (1990) Organic matter in lacustrine coal deposits (Calaf and Mequinenza sequences, eastern Ebro Basin, Spain. *Abstracts (posters) 13th Int. Sedimentol. Congr.* (Nottingham, UK), 26th-31st August 1990. British Geological Survey, Keyworth, Nottingham.
- DE LAS HERAS, F. X., GRIMALT, J.O. i ALBAIGÉS, J. (1991) Hidroxyacids and other oxygen-functionalised linear compounds in palaeolacustrine environments. A *Organic Geochemistry: Advances and Applications in Energy and the Natural Environment*. 15th International Meeting of the European Association of Organic Geochemistry, Manchester, England, September, 1991. Poster Abstracts, eds David Manning, pp. 354-357. A.I.G.O.A., Manchester University Press, Manchester. Anglaterra.
- DE LAS HERAS, F. X., GRIMALT, J.O., LOPEZ, J. F., ALBAIGÉS, J., SINNINGHE DAMSTÉ, J.S., i SCHOUTEN, S. (1997) Free and sulphurized hopanoids and highly branched isoprenoids in immature lacustrine oils shales. *Org. Geochem.* **27**, 41-63.
- DE LAS HERAS, F. X., LÒPEZ, J.F., GRIMALT, J.O. i ALBAIGÉS, J. (1993a) Origin and distribution of linear alkanones in oil shales. A *Organic Geochemistry. Poster Sessions from the 16th International Meeting on Organic Geochemistry*, Stavanger, Noruega, 22-24 September, 1993 (Editat per Øygard K.), pp. 592-596. Falch Hurtigtrykk, Oslo.
- DE LEEUW, J.W. i SINNINGHE DAMSTÉ, J.S. (1990) Organic sulfur compounds and other biomarkers as indicators of paleosalinity. A *Geochemistry of Sulfur in Fossil Fuels* (Edited by Orr, L. i White, C.M.), pp. 417-443. ACS Symposium Series 420, Washington, D.C.

- DE LEEUW, J.W., RIJPSRA, W. I. C. i SCHENCK, P.A. (1981) The occurrence and identification of C₃₀, C₃₁ and C₃₂ alkan-1,15-diols and alkan-15-one-1-ols in Unit I and Unit II Black Sea sediments. *Geochim. Cosmochim. Acta* **45**, 2281-2285.
- DE LEEUW, J.W., RIJPSRA, W. I. C., SCHENCK, P.A. i VOLKMAN, J.K. (1983) Free esterified and bound sterols in Black Sea Unit I sediments. *Geochim. Cosmochim. Acta* **47**, 455-465.
- DE LEEUW, J.W., RIJPSRA, W.I.C. i MUR, L.C. (1992) The absence of long-chain alkyl diols and alkyl keto-1-ols in cultures of the cyanobacterium *Aphanizomenon flos-aquae*. *Org. Geochem.* **18**, 575-578.
- DE LEEUW, J.W., RIJPSRA, W. I.C. i NIENHUIS, P.H. (1995) Free and bound fatty acids and hydroxy fatty acids in the living and decomposing eelgrass *Zostera marina* L. *Org. Geochem.* **23**, 721-728.
- DE LEEUW, J.W., SINNINGHE DAMSTÉ, J.S., KLOK, J., SCHENCK, P.A. i BOON, J.J. (1985) Biogeochemistry of Gavish Sabkha sediments. I. Studies on neutral reducing sugars and lipid moieties by gas-chromatography-mass spectrometry. In *Hypersaline Ecosystems* (Eds. G.M. Friedman i W.E. Krumbein), 350-367. Springer-Verlag.
- DE LEEUW, J.W., VAN DER MEER, F.W., RIJPSRA, W.I.C. i SCHENCK, P.A. (1980) On the occurrence and structural identification of long chain unsaturated ketones and hydrocarbons in sediments. *Adv. Org. Geochem.* 1979 (Eds. Douglas i Maxwell) 211-217. Pergamon Press.
- DE PASCUAL, J.T. i BERMEJO, B.J. (1966) Estudio de la gomorresina del *Cistrus ladanafirus* (L). *Anal. Real Soc. Esp. Fís. Quím.* **62b**, 569-582.
- DE WIT, R. i CAUMETTE, P. (1995) An overview of the brown-coloured isorenieratene-containing green sulphur bacteria (Chlorobiaceae). A *Organic Geochemistry: Developments and Applications to Energy, Climate, Environment and Human History*. 17th International Meeting on Organic Geochemistry, San Sebastián, Spain, 4-8 September, 1995. Abstracts, eds J. Grimalt i C. Dorronsoro, pp. 908-909. A.I.G.O.A., Donostia-San Sebastián, Espanya.
- DEL RIO, J.C., GARCÍA-MOLLA, J., GONZÁLEZ-VILA, F.J. i MARTÍN, F. (1994) Composition and origin of the aliphatic extractable hydrocarbons in the Puertollano (Spain) oil shale. *Org. Geochem.* **21**, 897-909.
- DEL RIO, J.C., GARCÍA-MOLLA, J., GONZÁLEZ-VILA, F.J. i MARTÍN, F. (1995) Organic geochemical characterization of oil shales from the Puertollano deposit. A *Organic Geochemistry: Developments and Applications to Energy, Climate, Environment and Human History*. 17th International Meeting on Organic Geochemistry, San Sebastián, Spain, 4-8 September, 1995. Abstracts, eds J. Grimalt i C. Dorronsoro, pp. 237-239. A.I.G.O.A., Donostia-San Sebastián, Espanya.

- DEMBITSKY, V.M. i REZANKA, T. (1996) Molecular species of wax esters in *Cereus peruvianus*. *Phytochem.* **42**, 1075-1080.
- DEMBITSKY, V.M., REZANKA, T. i BYCHEK, I.A. (1992) Lipid composition of some lichens. *Phytochem.* **31**, 1617-1620.
- DERENNE, S., LARGEAU, C. i TAULELLE, F. (1993) Elucidation, *via* solid-state ¹⁵N NMR, of the origin of the alkylnitriles generated upon pyrolysis of ultralaminae-containing kerogens. A *Organic Geochemistry. Poster Sessions from the 16th International Meeting on Organic Geochemistry*, Stavanger, Noruega, 22-24 September, 1993 (Editat per Øygard K.), pp. 766-770. Falch Hurtigtrykk, Oslo.
- DESSERT, D. i CONNAN, J. (1993) Occurrence of novel C-ring opened hopanoids in biodegraded oils from carbonate source rocks. A *Organic Geochemistry. Poster Sessions from the 16th International Meeting on Organic Geochemistry*, Stavanger, Noruega, 22-24 September, 1993 (Editat per Øygard K.), pp. 485-495. Falch Hurtigtrykk, Oslo.
- DIDYK, B.M., SIMONEIT, B.R.T., BRASSELL, S.C. i EGLINTON, G. (1978) Organic geochemical indicators of paleoenvironmental conditions of sedimentation. *Nature* **272**, 216-222.
- DISNAR, J.R. i HAROUNA, M. (1994) Biological origin of tetracyclic diterpanes, n-alkanes and other biomarkers found in Lower Carboniferous Gondwana coals (Niger). *Org. Geochem.* **21**, 143-152.
- DJERASSI, C., BUDZIKIEWICZ, H. i WILSON, J.M. (1962) Mass spectrometry in structural and stereochemical problems unsaturated pentacyclic triterpenoids. *Tetrahedron Lett.*, **7**, 263-270.
- DOBSON, G., WARD, D. M., ROBINSON, N. i EGLINTON, G. (1988) Biogeochemistry of hot spring environments: extractable lipids of a cyanobacterial mat. *Chem. Geol.* **68**, 155-179.
- DOUGLAS, A.G., DOURAGHI-ZADEH, K., EGLINTON, G., MAXWELL, J.R. i RAMSAY, J.N. (1966) Fatty acids in sediments including the Green River shale (Eocene) and Scottish torbanite (Carboniferous). *Adv. Org. Geochem.* (Eds. Hobson i Speers) 315-334. Pergamon Press.
- DOUGLAS, A.G., DOURAGHI-ZADEH, K. i EGLINTON, G. (1968) The fatty acid of the alga *Botriococcus braunii*. *Phytochem.* **8**, 285-293.
- DOUGLAS, A.G., SINNINGHE DAMSTÉ, J.S., FOWLER, M.G., EGLINTON, T.I. i DE LEEUW, J.W. (1991) Unique distributions of hydrocarbons and sulphur compounds released by flash pyrolysis from the fossilised alga *Gloeocapsomorpha prisca*, a major constituent in one of four Ordovician kerogens. *Geochim. Cosmochim. Acta* **55**, 275-291.

- DUAN, H.G., KAWAZOE, K., BANDO, M., KIDO, M. i TAKAISHI, Y. (1997) Di- and triterpenoids from *Tripterygium Hypoglaucum*. *Phytochem.* **46**, 535-543.
- DUNLOP, R.W. i JEFFERIES, P.R. (1985) Hydrocarbons of the hypersaline basins of Shark Bay, Western Australia. *Org. Geochem.* **8**, 216-222.
- DZOU, L.I.P. i HUGHES, W.B. (1993) Geochemistry of oils and condensates, K Fields, offshore Taiwan: a case study in migration fractionation. *Org. Geochem.* **20**, 437-462.
- DZOU, L.I.P., NOBLE, R.A. i SENFTLE, J.T. (1995) Maturation effects on absolute biomarker concentration in a suite of coals associated vitrinite concentrates. *Org. Geochem.* **23**, 681-697.
- EGLINTON, G. i HAMILTON, R.J. (1963) The distribution of alkanes. "Chemical Taxonomy" (Eds. Swain) 187-208. Academic Press.
- EGLINTON, G. i HAMILTON, R.J. (1967) Leaf epicuticular waxes. *Science* **156**, 1322.
- EGLINTON, G. i HUNNEMAN, D.H. (1968) Gas Chromatographic-Mass Spectrometric Studies of Long Chain Hydroxy Acids-I. The constituent cutin acids of apple cuticle. *Phytochem.* **7**, 313-322.
- EGLINTON, G., GONZALEZ, A.G., HAMILTON, R.J. i RAPHAEL, R.A. (1962) Hydrocarbon constituents of the wax coatings of plants leaves, a taxonomic survey. *Phytochem.* **1**, 89-102.
- EGLINTON, G., HUNNEMAN, D.H. i DOURAGHI-ZADEH, K. (1968a) Gas Chromatographic-Mass Spectrometric Studies of Long Chain Hydroxy Acids-II. The hydroxy acids and fatty acids of a 5000-year-old lacustrine sediment. *Tetrahedron* **14**, 5929-5941.
- EGLINTON, G., HUNNEMAN, D.H. i MCCORMICK, A. (1968b) Gas Chromatographic-Mass Spectrometric Studies of Long Chain Hydroxy Acids.-III. The mass spectra of the methyl esters trimethylsilyl ethers of aliphatic hydroxy acids. A facile method of double bond location. *Organic Mass Spectrom.* **1**, 593-611.
- EKWEAZOR, C.M., OKOGUN, J.I., EKON, D.E.U. i MAXWELL, J.R. (1979a) Preliminary geochemical studies of samples from the Niger Delta (Nigeria). I. Analyses of crude oils for triterpanes. *Chem. Geol.* **27**, 11-28.
- EKWEAZOR, C.M., OKOGUN, J.I., EKON, D.E.U. i MAXWELL, J.R. (1979b) Preliminary geochemical studies of samples from the Niger Delta (Nigeria). II Analyses of crude oils for triterpenoid derivatives. *Chem. Geol.* **27**, 29-37.
- ELOVSON, J. (1974). Biosynthesis of Chlorosulfolipids in *Ochromonas danica*. Assembly of the Docosane-1,14-diols Structure *in Vivo*. *J. Biochem.* **13**, 3483-3486.

- ENSMINGER, M (1974) Triterpens de sédiments. Evolution de composés polycycliques sédimentaires. Tesi Doctoral, Universitat Louis Pasteur, Estrasburg.
- ENSMINGER, A., JOLY, G. i ALBRECHT, P. (1978) Rearranged steranes in sediments and crude oils. *Tetrahedron Lett.* **18**, 1575-1578.
- ENSMINGER, A., VAN DORSSELAER, A., SPYCKERELLE, C., ALBRECHT, P. i OURISSON, G. (1974) Pentacyclic triterpanes of the hopane type as ubiquitous geochemistry markers: Origin and significance. In: *Advances in Organic Geochemistry 1973* (Eds. B.P. Tissot and F. Bierner) Editions Technip, Paris, 245-260.
- FANG, J. i BARCELONA, J.M. (1998) Biodegradation evidence for microbial community change in a jet fuel hydrocarbons-contaminated aquifer. *Org. Geochem.* **29**, 899-907.
- FARRIMOND, P. i TELNAES, N. (1993) Hopanes and methylhopanes in Cretaceous marls from Tunisia. A *Organic Geochemistry. Poster Sessions from the 16th International Meeting on Organic Geochemistry*, Stavanger, Noruega, 22-24 September, 1993 (Editat per Øygard K.), pp. 427-430. Falch Hurtigtrykk, Oslo.
- FARRIMOND, P. i TELNAES, N. (1996) Three series of rearranged hopanes in Toarcian sediments (northern Italy). *Org. Geochem.* **25**, 165-177.
- FARRIMOND, P., STODDART, D.P. i JENKYNS, H.C. (1994) An organic geochemical profile of the Toarcian anoxic event in northern Italy. *Chem. Geol.* **111**, 17-33.
- FARRINGTON, J.W., DAVIS, A.C., TARAFKA, M.E., MCCAFFREY, M.A., WHELAND, J.K. i HUNT, J. M. (1988) Bitumen molecular maturity in the Ikpikpuk well, Alaskan north slope. *Adv. Org. Geochemistry 1987. Org. Geochem.* **13**, 303-310.
- FICKEN, K.J., BARBER, K.E. i EGLINTON, G. (1998) Lipid biomarker, $\delta^{13}\text{C}$ and plant macrofossil stratigraphy of a Scottish montane peat bog over the last two millennia). *Org. Geochem.* **28**, 217-237.
- FISHER, E., WOLFF, G., OLDFIELD, F., REBECCA, W., THOMPSON, R., BARLOW, D. i APPLEBY, P. (1997) Characterization and flux of terrestrially-derived sediments in Humber Region. A *Organic Geochemistry. 18th International Meeting on Organic Geochemistry*, Maastricht, The Netherlands, 22-26 September, 1997. Abstracts Part I, pp. 289-290. Forschungszentrum Jülich, Alemanya.
- FOWLER, M.G. i DOUGLAS, A.G. (1984) Distribution and structure of hydrocarbons in four organic-rich Ordovician rocks. *Org. Geochem.* **1**, 105-114.
- FOWLER, M.G., ABOLINS, P. i DOUGLAS, A.G. (1986) Monocyclic alkanes in Ordovician organic matter. *Org. Geochem.* **13**, 815-823.

- FRANICH, R.A. i VOLKMAN, J.K. (1982) Constituent acids of *pinus radiata* stem cutin. *Phytochem.* **21**, 2687-2689.
- FREWIN, N.L., KILLOPS, S.D., VAN BERGEN, P.F., DE LEEUW, J.W. i COLLINSON, M.E. (1993) Preservation potential of biomacromolecules of higher plant cuticles in Florida Bay. A *Organic Geochemistry. Poster Sessions from the 16th International Meeting on Organic Geochemistry*, Stavanger, Noruega, 22-24 September, 1993 (Editat per Øygard K.), pp. 566-569. Falch Hurtigtrykk, Oslo.
- FUKUSHIMA, K. i ISHIWATARI, R. (1988) Geochemical significance of lipids and lipid-derived substructures interlaced in kerogen. *Org. Geochem.* **12**, 509-518.
- FUKUSHIMA, K., YASUKAWA, M., MUTO, N., UEMERA, H. i ISHIWATARI, R. (1992) Formation of C₂₀ isoprenoid thiophenes in modern sediments. *Org. Geochem.* **18**, 83-92.
- FULCO, A.J. (1974) Metabolic altering of fatty acid. *Ann. Rev. Biochem.* **43**, 215-241.
- FULCO, A.J., LEVY, R. i BLOCH, K. (1964) The biosynthesis of Δ^9 and Δ^5 monounsaturated fatty acids by bacteria. *J. Biol. Chem.* **239**, 998-1003.
- GAGOSIAN, R.B. i NIGRELLI, G.E. (1979) The transport and budget of sterols in the western North Atlantic Ocean. *Limnol. Oceanogr.* **24**, 839-849.
- GAGOSIAN, R.B., SMITH S.O., LEE, C., FARRINGTON, J.W. i FREW, N.M. (1980) Steroid transformations in recent marine sediments. In *Advances in Organic Geochemistry 1979* (Edited by Douglas, A.G. i Maxwell, J.R.), 407-419. Pergamon Press, Oxford.
- GALLANGO, O. i CASSANI, F. (1992) Biological marker maturity parameters of marine crude oils and rock extracts from Maracaibo Basin, Venezuela. *Org. Geochem.* **18**, 215-224.
- GARCÍA MOLLÁ, J. (1994) Análisis de biomarcadores y geopolímeros en diferentes estratos de pizarras bituminosas de la cuenca de Puertollano. Tesi Doctoral, Universitat de Sevilla.
- GARCÍA, S., HEINZEN, H., HUBBUCH, C., MARTÍNEZ, R., DE VRIES, X. i MOYNA, P. (1995) Triterpene methyl ethers from palmae epicuticular waxes. *Phytochem.* **39**, 1381-1382.
- GARCIA-SENZ, J.M., BERÁSTEGUI, X., i LOSANTOS, M. (1991) La cuenca de Organyà. Estratigrafia. A: Beràstegui, X., Losantos, M (Eds.). El Cretácico inferior de la Cuenca de Organyà (Lamina Cabalgante de Boixols). *III Coloquio del Cretácico de España, excursion guide*. Publicacions Universitat de Barcelona, 1995, 1^a edició, pp. 97-127.

- GARRIGUES, P., SAPTORAHARDJO, A., GONZALEZ, C., SEHRUNG, P.W., ALBRECHT, P., SALIOT, A. i EWALD, A. (1985) Biogeochemical aromatic markers in the sediments from Mahakam Delta (Indonesia). *Org. Geochem.* **10**, 959-964.
- GASKELL, S.J. i EGLINTON, G. (1976) Sterols of a contemporary lacustrine sediment. *Geochim. Cosmochim. Acta* **40**, 1221-1228.
- GEARING, P., GEARING, J.N., LYTLE, T.F. i LYTLE, J.S. (1976) Hydrocarbons in 60 northeast Gulf of Mexico shelf sediments: a preliminary survey. *Geochim. Cosmochim. Acta* **40**, 1005-1017.
- GELIN, F., BOOGERS, I., NOORDELOOS, A.A.M., SINNINGHE DAMSTÉ, J.S., HATCHER, P.G. i DE LEEUW, J.W. (1996) Novel, resistant microalgal polyethers: An important sink of organic carbon in the marine environment? *Geochim. Cosmochim. Acta* **60**, 1275-1280.
- GELIN, F., BOOGERS, I., NOORDELOOS, A.A. M., SINNINGHE DAMSTÉ, J.S., RIEGMAN, R. i DE LEEUW, J.W. (1997) Resistant biomacromolecules in marine microalgae of the classes Eustigmatophyceae and Chlorophyceae: Geochemical implications. *Org. Geochem.* **26**, 659-675.
- GELIN, F., VOLKMAN, J.K., LARGEAU, C., DERENNE, S., SINNINGHE DAMSTÉ, J.S. i DE LEEUW, J.W. (1999) Distribution of aliphatic, nonhydrolyzable biopolymers in marine microalgae. *Org. Geochem.* **30**, 147-159.
- GELIN, F., BOOGERS, I., NOORDELOOS, A.A. M., SINNINGHE DAMSTÉ, J.S., RIEGMAN, R. i DE LEEUW, J.W. (1997) Resistant biomacromolecules in marine microalgae of the classes Eustigmatophyceae and Chlorophyceae: Geochemical implications. *Org. Geochem.* **26**, 659-675.
- GELPI, E., SCHNEIDER, H., MANN, H. i ORO, J. (1970) Hydrocarbons of geochemical significance in microscopic algae. *Phytochem.* **9**, 603-612.
- GEORGE, S.C. i JARDINE, D.R. (1994) Ketones in a proterozoic dolerite sill. *Org. Geochem.* **21**, 829-839.
- GEORGE, S.C., LISK, M., SUMMONS, R.E. i QUEZADA, R.A. (1997) Describing the oil charge history of the South Pepper oilfield from the analysis of oil-bearing fluid inclusions. A *Organic Geochemistry*. 18th International Meeting on Organic Geochemistry, Maastricht, The Netherlands, 22-26 September, 1997. Abstracts Part I, pp. 21-22. Forschungszentrum Jülich, Alemanya.
- GHOSH, A., MISRA, S., DUTTA, A.K. i CHOUDHURY, A. (1985) Pentacyclic triterpenoids and sterols from seven species of mangrove. *Phytochem.* **24**, 1725-1727.
- GIBERT, J. (1999) Del Congreso a las actas: un largo y definitivo camino. *The Hominids and their Environment during the Lower and Middle Pleistocene of*

Eurasia. Proceedings of the International Conference of Human Palaeontology, Orce 1995. Editat per: J. Gibert, F. Sánchez, L. Gibert i F. Ribot, pp. 9-15. Museo de Prehistoria y Paleontología "J. Gibert". Ayuntamiento de Orce.

GIBERT, J., GIBERT, L. i IGLESIAS, A. (1999) Acción antrópica e industrias líticas en la región de Orce. *The Hominids and their Environment during the Lower and Middle Pleistocene of Eurasia*. Proceedings of the International Conference of Human Palaeontology, Orce 1995. Editat per: J. Gibert, F. Sánchez, L. Gibert i F. Ribot, pp. 113-120. Museo de Prehistoria y Paleontología "J. Gibert". Ayuntamiento de Orce.

GIBERT, L., ALBADALEJO, S. i GIBERT, J. (1999a) Estratigrafia del barranco de Orce. *The Hominids and their Environment during the Lower and Middle Pleistocene of Eurasia*. Proceedings of the International Conference of Human Palaeontology, Orce 1995. Editat per: J. Gibert, F. Sánchez, L. Gibert i F. Ribot, pp. 145-151. Museo de Prehistoria y Paleontología "J. Gibert". Ayuntamiento de Orce.

GIBERT, L., MAESTRO, E. i GIBERT, J. (1999b) Clima i tectónica en la evolución de la cuenca de Guadix-Baza. Pendent de Publicació.

GIBERT, L., MAESTRO, E., GIBERT, J. i ALBADALEJO, S. (1999c) Plio-Pleistocene deposits of the Orce region (SE Spain): Geology and Age. *The Hominids and their Environment during the Lower and Middle Pleistocene of Eurasia*. Proceedings of the International Conference of Human Palaeontology, Orce 1995. Editat per: J. Gibert, F. Sánchez, L. Gibert i F. Ribot, pp. 127-144. Museo de Prehistoria y Paleontología "J. Gibert". Ayuntamiento de Orce.

GIGER, W., SCHAFFNER, C. i WAKEHAM, S.C. (1980) Aliphatic and olefinic hydrocarbons in recent sediments of Greifensee, Switzerland. *Geochim. Cosmochim. Acta* **44**, 119-129.

GIL-SERRANO, A.M., GONZÁLEZ-JIMÉNEZ, I., TEJERO-MATEO, P., MEGÍAS, M. i ROMERO-VÁZQUEZ, M.J. (1994) Analysis of the lipids of lipopolysaccharide from *Rhizobium tropici* CIAT899: identification of 29-hydroxytriacontanoic acid. *J. Bacteriol.* **176**, 2454-2457.

GILLAN, F.T. i SANDSTROM, M.W. (1985) Microbial lipids from a nearshore sediment from Bowling Green Bay, North Queensland: the fatty acid composition of intact lipid fractions. *Org. Geochem.* **8**, 321-328.

GILLAN, F.T., HOGG, R.W. i DREW, E.A. (1984) The sterol and fatty acid compositions of seven tropical seagrasses from north Queensland, Australia. *Phytochem.* **23**, 2817-2821.

GINER, R.M., GRAY, A.I., GIBBONS, S. i WATERMAN, P.G. (1993) Friedelane triterpenes from the stem bark of *Caloncoba glauca*. *Phytochem.* **33**, 237-239.

- GOOSSENS, H., DE LEEUW, J.W., SCHENCK, P.A. i BRASSELL, S.C. (1984) Tocopherols as likely precursors of pristane in ancient sediments and crude oils. *Nature* **312**, 440-442.
- GOOSSENS, H., DUREN, R.R., DE LEEUW, J.W. i SCHENCK, P.A. (1989) Lipids and their mode of occurrence in bacteria and sediments-II. Lipids in the sediments of a stratified, freshwater lake. *Org. Geochem.* **14**, 27-41.
- GOOSSENS, H., RIJSPSTRA, W.I.C., DÜREN, R.R., DE LEEUW, J.W. i SCHENCK, P.A. (1986) Bacterial contribution to sedimentary organic matter; a comparative study of lipid moieties in bacteria and recent sediments. *Org. Geochem.* **10**, 683-696.
- GORCHS, R. (1998) Geoquímica orgànica dels carbons rics en sofre. Tesi Doctoral, Universitat Politècnica de Catalunya.
- GORCHS, R., RIUS, R. DE LAS HERAS, F.X., GRIMALT, J.O. i CABRERA, L. (1993) Hydrocarbon biomarkers in the sulphur-rich Mequinensa coals. A *Organic Geochemistry. Poster Sessions from the 16th International Meeting on Organic Geochemistry*, Stavanger, Noruega, 22-24 September, 1993 (Editat per Øygaard K.), pp. 461-465. Falch Hurtigtrykk, Oslo.
- GORGEN, C. i BOLAND, W. (1989) Biosynthesis of 1-alkenes in higher plants: Stereochemical implications. A model study with *Carthamus tinctorius* (Asteraceae). *Eur. J. Biochem.* **185**, 237-242.
- GOUGH, L.J. i MILLS, J.S. (1972) The composition of succinite (Baltic amber). *Nature* **239**, 527-528.
- GRAMBERG, D., SCHOLZ-BÖTTCHER, M. i RULLKÖTTER, J. (1995) Column chromatographic separation and characterization of a complex mixture of heterocompounds in the extractable lipids of a *phragmites* peat. A *Organic Geochemistry: Developments and Applications to Energy, Climate, Environment and Human History*. 17th International Meeting on Organic Geochemistry, San Sebastián, Spain, 4-8 September, 1995. Abstracts, eds J. Grimalt i C. Dorronsoro, pp. 174-177. A.I.G.O.A., Donostia-San Sebastián, Espanya.
- GRASSET, L. i AMBLÈS, A. (1998) Structure of humic acid from an acid soil as revealed by phase transfer catalyzed hydrolysis. *Org. Geochem.* **29**, 881-891.
- GRICE, K., SCHOUTEN, S., NISSENBAUM, A., CHARRACH, J. i SINNINGHE DAMSTÉ, J.S. (1998) A remarkable paradox: Sulfurised freshwater algal (*Botryococcus braunii*) lipids in an ancient hypersaline euxinic ecosystem. *Org. Geochem.* **28**, 195-216.
- GRICE, K., SCHWARK, L., SCHAEFFER, P., ECKADT, B. i MAXWELL, J.R. (1995) Stable carbon isotopic compositions and distributions of biomarkers in the Permian Kupferschiefer. A *Organic Geochemistry: Developments and Applications to Energy, Climate, Environment and Human History*. 17th International Meeting on

Organic Geochemistry, San Sebastián, Spain, 4-8 September, 1995. Abstracts, eds J. Grimalt i C. Dorronsoro, pp. 61-64. A.I.G.O.A., Donostia-San Sebastián, Espanya.

- GRIMALT, J.O. (1983) Geoquímica orgànica de sistemes deltaics. Tesi Doctoral. Universitat Autònoma de Barcelona.
- GRIMALT, J.O. i ALBAIGÉS, J. (1987) Sources and occurrence of C₁₂-C₂₂ *n*-alkane distributions with even carbon number preference in sedimentary environments. *Geochim. Cosmochim. Acta* **51**, 1379-1384.
- GRIMALT, J.O. i ALBAIGÉS, J. (1990) Characterization of the depositional environments of the Ebro Delta (western Mediterranean) by the study of sedimentary lipids markers. *Mar. Geol.* **95**, 207-224.
- GRIMALT, J.O., DE WIT, R., TEIXIDOR, P. i ALBAIGÉS, J. (1992) Lipid biogeochemistry of *Phormidium* and *Microcoleus* mats. *Org. Geochem.* **19**, 509-530.
- GRIMALT, J.O., GRIFOLL, M., SOLANAS, A.M. i ALBAIGÉS, J. (1991a) Microbial degradation of marine evaporitic crude oils. *Geochim. Cosmochim. Acta* **55**, 1903-1913.
- GRIMALT, J.O., SIMONEIT, B.R.T., HATCHER, P.G. i NISSENBAUM, A. (1988) The molecular composition of ambers. *Org. Geochem.* **13**, 677-690.
- GRIMALT, J.O., YRUELA, I., SAIZ-JIMENEZ, C., TOJA, J., DE LEEUW, J.W. i ALBAIGÉS, J. (1991b) Sedimentary lipid biogeochemistry of an hypereutrophic alkaline lagoon. *Geochim. Cosmochim. Acta* **55**, 2555-2577.
- GROSSI, V., HIRSCHLER, A., RAPHEL, D., RONTANI, J.F., DE LEEUW, J.W. i BERTRAND, J.C. (1998) Biotransformation pathways of phytol in recent anoxic sediments. *Org. Geochem.* **29**, 845-861.
- GÜLZ, P.G. (1994) Epicuticular leaf waxes in the evolution of the plant kingdom. *J. Plant Physiol.* **143**, 453-464.
- HAACK, S.K., GARCHOW, H., ODELSON, D.A., FORNEY, L.J. i KLUG, M.J. (1994) Accuracy, Reproducibility, and Interpretation of Fatty Acid Methyl Ester Profiles of Model Bacterial Communities. *Appl. Environ. Microbiol.* **60**, 2483-2493.
- HADDAD, R.I., MARTENS, C.S. i FARRINGTON, J.W. (1992) Quantifying early diagenesis of total fatty acids in a rapidly accumulating coastal marine sediment. *Org. Geochem.* **19**, 205-216.
- HAI, T., SCHNEIDER, B., SCHMIDT, J. i ADAM, G. (1996) Sterols and triterpenoids from the cyanobacterium *Anabaena hallensis*. *Phytochem.* **41**, 1083-1084.
- HALL, P.B. i DOUGLAS, A.G. (1983) The distribution of cyclic alkanes in two lacustrine deposits. *Adv. Org. Geochem.* 1981. (Eds. Bjorøy *et al.*), 576-587. Wiley & Sons.

- HARTGERS, W.A., SINNINGHE DAMSTÉ, J.S., REQUEJO, A.G., ALLAN, J., HAYES, J.M., LING, Y., XIE, T.M., PRIMACK, J. i DE LEEUW, J.W. (1994) A molecular and carbon isotope study towards the origin and diagenetic fate of diaromatic carotenoids. *Organic Geochem.* **22**, 703-725.
- HARVEY, H.R. i MCMANUS, G.B. (1991) Marine ciliates as a widespread source of tetrahymanol and hopan-3 β -ol in sediments. *Geochim. Cosmochim. Acta* **55**, 3387-3390.
- HATCHER, P.G., SIMONEIT, B.R.T., MACKENZIE, F.T., NEUMAN, A. C., THORSTENSON, D.C. i GERCHAKOV, S.M. (1982) Organic geochemistry and pore water chemistry of sediments from Mangrove Lake, Bermuda. *Org. Geochem.* **4**, 93-112.
- HAUG, P., SCHNOES, H.K. i BURLINGAME, A.L. (1967) Ketocarboxylic acids isolated from the Colorado Green River shale (Eocene). *J. Chem. Soc. Chem. Comm.* 1130.
- HAUKE, V., GRAFF, R., WEHRUNG, P., TRENDEL, J.M. i ALBRECHT, P. (1992) Novel triterpene-derived hydrocarbons of arborane/fernane series in sediments. Part I. *Tetrahedron* **48**, 3915-3924.
- HAUKE, V., TRENDEL, J.M., CONNAN, J. i ALBRECHT, P. (1993) Organic geochemistry of an actual freshwater lacustrine sediment: biomarkers as indicators of paleoenvironment and paleoclimatic history. A *Organic Geochemistry. Poster Sessions from the 16th International Meeting on Organic Geochemistry*, Stavanger, Noruega, 22-24 September, 1993 (Editat per Øygard K.), pp. 317-320. Falch Hurtigtrykk, Oslo.
- HAYASAKA, S. i KLISHE, D.A. (1971) Structural effects on *Arthrobacter* methylene hydroxylase activity. *J. Bacteriol.* **108**, 1141-1146.
- HEINZ, E., TULLOCH, A.P. i SPENCER, J.F.T. (1969) Stereospecific hydroxylation of long chain compounds by a species of *Turolopsis*. *J. Biol. Chem.* **244**, 882-888.
- HENDRIX, M.S. i BRASSELL, S.C. (1993) Sources of organic matter in widespread Jurassic coal from north-west China: geochemical comparisons of samples from the Junggar, Tarim and Turpan basins. A *Organic Geochemistry. Poster Sessions from the 16th International Meeting on Organic Geochemistry*, Stavanger, Noruega, 22-24 September, 1993 (Editat per Øygard K.), pp. 349-352. Falch Hurtigtrykk, Oslo.
- HEPPENHEIMER, H., STEFFENS, K., PÜTTMANN, W. i KALKREUTH, W. (1992) Comparison of resinite-related aromatic biomarker distribution in Cretaceous-Tertiary coals from Canada and Germany. *Org. Geochem.* **18**, 273-287.
- HERNÁNDEZ, M. i JAFFE, R. (1997) Molecular characterization of sedimentary organic matter from the Florida Everglades and the Florida. A *Organic Geochemistry. 18th International Meeting on Organic Geochemistry*, Maastricht, The Netherlands,

22-26 September, 1997. Abstracts Part I, pp. 421-422. Forschungszentrum Jülich, Alemanya.

HERNÁNDEZ SAMPELAYO, P. i CINCUÉNEGUI, M. (1926) Cuenca de esquistos bituminosos de Ribesalbes. *Bol. I.G.M.E.* **46**, 1-86.

HIETALA, T., LAAKSO, S. i ROSENQVIST, H. (1995) Epicuticular waxes of *salix* species in relation to their overwintering survival and biomass productivity. *Phytochem.* **40**, 23-27.

HILLS, I.R., WHITEHEAD, E.V., ANDERS, D.E., CUMMINS, J.J. i ROBINSON, W.E. (1966) An optically active triterpane, gammacerane, in Green River, Colorado, oil shale bitumen. *J. Chem. Soc., Chem. Commun.*, 752-754.

HIRD, S.J., EVENS, R. i ROWLAND, S.J. (1992) Isolation and characterization of sedimentary and synthetic highly branched C₂₀ and C₂₅ monoenes. *Mar. Chem.* **37**, 117-129.

HISHAM, A., JAYA KUMAR, G., FUJIMOTO, Y. i HARA, N. (1996) 20,29-Epoxyalacianone and 6 β -hydroxyalacianone, two lupane triterpenes from *Salacia beddomei*. *Phytochem.* **42**, 789-794.

HO, E.S. i MEYERS, P.A. (1994) Variability of early diagenesis in lake sediments: Evidence from the sedimentary geolipid record in an isolated tarn. *Chem. Geol.* **112**, 309-324.

HOEFS, M.J.L., SCHOUTEN, S., DE LEEUW, J.W., SINNINGHE DAMSTÉ, J.S., WAKEHAM, S.G. i KING, L.L. (1997) Ether lipids of planktonic archaea in the marine water column. *Appl. Environ. Microbiol.* **63**, 3090-3095.

HOEFS, M.J.L., SINNINGHE DAMSTÉ, J.S. i DE LEEUW, J.W. (1995a) A novel C₃₅ highly branched isoprenoid polyene in Recent Indian Ocean sediments. *Org. Geochem.* **23**, 263-267.

HOEFS, M.J.L., SINNINGHE DAMSTÉ, J.S. i DE LEEUW, J.W. (1995b) Organic geochemistry of Arabian Sea surface sediments: Paleoenvironmental implications. A *Organic Geochemistry: Developments and Applications to Energy, Climate, Environment and Human History*. 17th International Meeting on Organic Geochemistry, San Sebastián, Spain, 4-8 September, 1995. Abstracts, eds J. Grimalt i C. Dorronsoro, pp. 158-160. A.I.G.O.A., Donostia-San Sebastián, Espanya.

HOFFMANN, C.F., FOSTER, C.B., POWELL, T.G. i SUMMONS, R.E. (1987) Hydrocarbon biomarkers from Ordovician sediments and the fossil alga *Gloeocapsomorpha prisca* Zalesky 1917. *Geochim. Cosmochim. Acta* **51**, 2681-2697.

HOFFMANN, C.F., MACKENZIE, A.S., LEWIS, C.A., MAXWELL, J.R., OUDIN, J.L., DURAND, B. i VANDENBROUCKE, M. (1984) A biological markers study of